natural
scotland
SCOTTISH GOVERNMENT
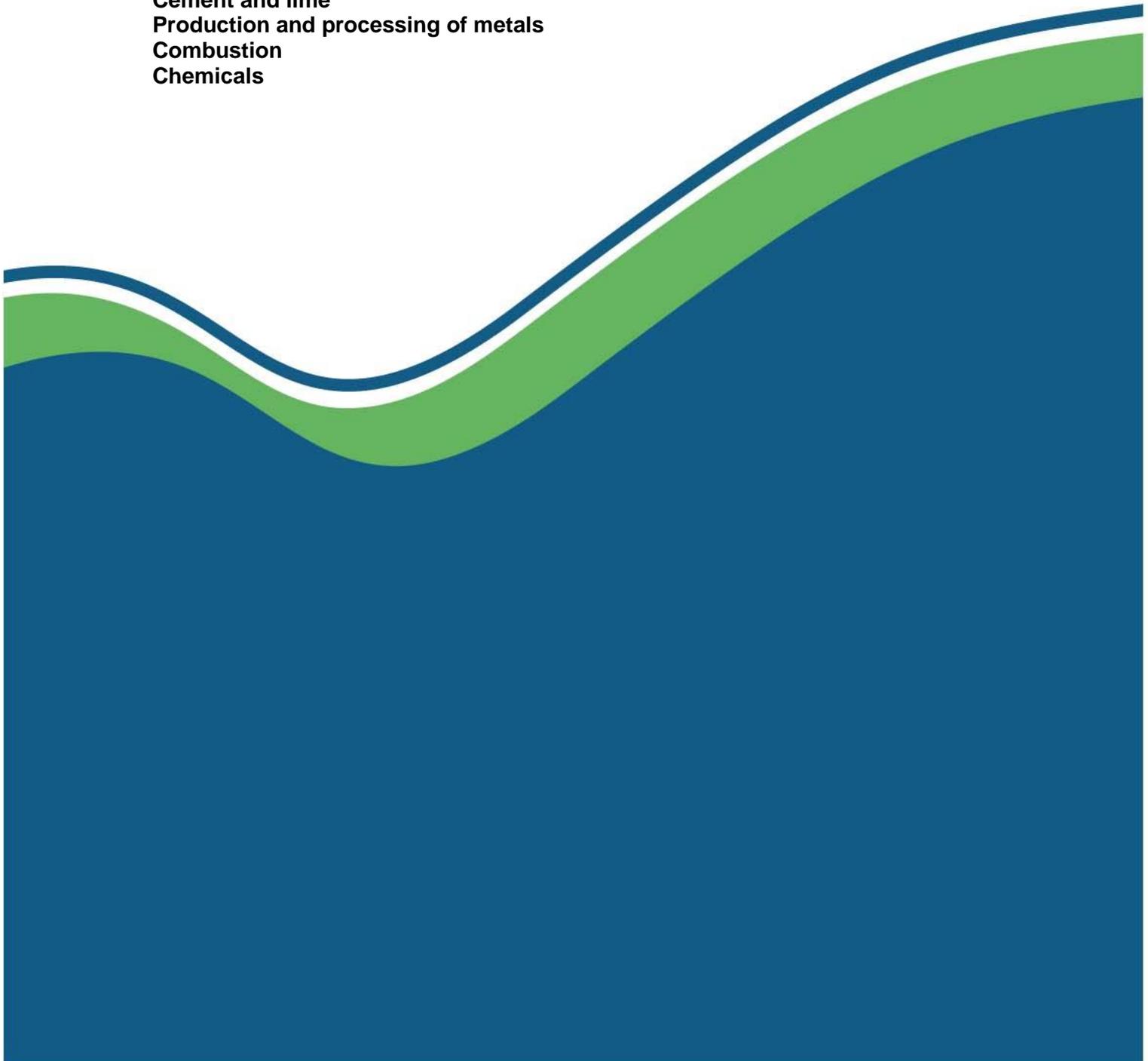
SEPA
Scottish Environment
Protection Agency

Scottish Pollutant Release Inventory Reporting

Sector Guidance Note

2017

Petroleum
Incineration
Paper and wood production and processing
Cement and lime
Production and processing of metals
Combustion
Chemicals

CONTENTS

1   Introduction

This Guidance Note provides information to assist you in preparing submissions to the Scottish Pollutant Release Inventory (SPRI). It has been developed through a process of consultation between industry stakeholders and ourselves.   It is part of a range of non-statutory guidance and tools produced to assist in the completion of the annual SPRI return. Information on the range of guidance notes is available on the SPRI website.

By providing a series of guidance notes, we seek to ease the burden on industry and to raise the quality of SPRI data. In addition, the increasing use of SPRI data in policy-making and for comparisons on a sector and national basis has led to a need for increased consistency in SPRI data and an improved understanding of uncertainty.

1.1   Scope of the guidance note

This note contains guidance on specific industry sectors and should be used in conjunction with the General SPRI Guidance Note 2017 and the Release Estimation Techniques (RET) Guidance Note 2017 to ensure that you meet the reporting requirements of the E-PRTR Regulation. The General Guidance Note includes a more prescriptive indication of methods of measurement and calculation and a requirement to report certain releases to land while the RET Guidance Note contains information on determining the most appropriate RETs to calculate the annual SPRI emission values. Data on transboundary shipments of hazardous and non-hazardous waste taking place during the reporting year must also be reported to meet the E-PRTR requirements

Note that you are not required to include any emissions due to historic activities (for example, from contaminated land) in your SPRI return unless the original contamination is related to an ongoing activity.

Emissions reported need only relate to operations of the permitted activity (direct emissions from point and fugitive sources) or from the E-PRTR activity (where it differs from the permit or is not a permitted activity) and from unauthorised or unplanned events termed "accidental" emissions (e.g. resulting from equipment failure).

For accidental emissions you should not include any emissions resulting from routine maintenance, such as the release associated with recharging cooling fluids.

1.2   Access to further information

This Note does not provide detailed information on suggested measurement and monitoring techniques as this is dealt with extensively in other guidance documents that we publish. References to monitoring guidance and other sources of reference information are included in the relevant sections of this document.

1.3   Disclosing information you provide

The General SPRI Guidance Note provides information relating to commercial confidentiality.

1.4   Feedback

In order to improve the quality of our guidance, we would like to receive feedback from you on your experiences in using this Note. Such feedback will be taken into account in the preparation of other guidance notes in this series, and in the updating of this document.

Feedback should be submitted to the SPRI team by email: SPRIAdminstration@sepa.org.uk

1.5   Useful references

The following are general references and further information you may find useful. Any references specific to a particular sector will be contained in the relevant section of this guidance note.

1. Scottish Pollutant Release Inventory website

2. The Pollution Prevention and Control (Scotland) Regulations 2012 (as amended) SSI 2012 No. 360

3. SEPA Scottish Pollutant Release Inventory General Guidance Document

4. Scottish Pollutant Release Inventory (SPRI) Operator Guidance on Release Estimation Techniques (RET)

5. Scottish Pollutant Release Inventory (SPRI) Operator Reporting System Guidance 2017

6. Schedule to notice

7. UK-PRTR website

8. E-PRTR website

9. Industrial Emissions Directive (2010/75/EU)

10. European Union Emissions Trading System (EU ETS) Directive

11. EU Emissions Trading System guidelines for the monitoring and reporting of greenhouse gas emissions

12. Monitoring, reporting and verification of EU ETS emissions

13. European Commission

14. EC Aarhus Convention

2 Petroleum sector guidance

This Section covers activities that are regulated as "Gasification, liquefaction and refining activities" under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended; PPC Regulations). Included within the scope are Part A prescribed/listed activities regulated under Chapter 1, Section 1.2 of the PPC Regulations.

2.1 Air emissions

The main air emissions from a refinery are CO_2, CO, SO_x, NO_x, VOC and particulate matter (dust and associated heavy metals). They arise typically from sources such as stacks of process furnaces and boilers, regenerators (fluidised catalytic cracking units), individual items such as valves and pump seals and to a lesser extent from flares and incinerator stacks. Reference Table 1 contains references to UKPIA's "Pollution Inventory – Guidance for Refineries" document, which covers the major categories of refinery emission sources. The document is split into three categories of pollutant; those that will almost certainly be emitted in quantities above the reporting threshold, those emitted but generally in quantities below the reporting threshold and those that are unlikely to be emitted by refineries.

The following table provides a brief summary of the main pollutants released by a refinery and should be taken as a guide only, and you should verify that there are no other pollutants emitted from your installation.

Table 1 – Main air pollutants emitted by refineries and their main sources

Main air pollutants	Main sources
CO_2	Process furnaces, boilers, gas turbines, fluidised catalytic cracking regenerators, CO boilers, flare systems, incinerators.
CO	Process furnaces, boilers, gas turbines, fluidised catalytic cracking regenerators, CO boilers, flare systems, incinerators, sulphur recovery units.
NO_x	Process furnaces, boilers, gas turbines, fluidised catalytic cracking regenerators, CO boilers, flare systems, incinerators, coke calciners.
Particulate matter (including PM_{10})	Process furnaces, boilers, particularly fluidised catalytic cracking regenerators, CO boilers, incinerators, coke calciners.
SO_x	Process furnaces, boilers, gas turbines, fluidised catalytic cracking regenerators, CO boilers, flare systems, incinerators, sulphur recovery units, coke calciners.
VOCs	Storage and handling facilities, gas separation units, oil/water separation systems, fugitive emissions (valves, flanges, etc.), vents, flare systems.

2.1.1 Emission sources

These emissions are exhausted via a stack or vent; i.e. a single point source into the atmosphere. Abatement equipment; e.g. scrubbing units, fabric filters (bag house) can be incorporated into the exhaust system prior to discharge to atmosphere. Point source emissions will be the most significant emission source for combustion activities taking place within refineries as well as occurring from refinery process sources (e.g. vacuum distillation, catalytic cracking, sulphur recovery, etc.).

2.1.2 Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack. Examples of fugitive emissions from refineries include VOC emissions from piping systems, wastewater systems, storage tanks, loading and unloading systems and storage and handling. Although the release from each individual source may be small, diffuse VOC emission sources such as pumps, compressors, valves and flanges may contribute 20-50% of the total VOC emissions due to the large number of such sources in a refinery. Only fugitive emissions that leave the site need to be reported to the SPRI. Whilst contained spills would therefore not need to be reported, you should report vapour emissions that may have dispersed.

Estimation of fugitive VOC emissions is dealt with below in Section 2.3.4.

(a)   Combustion source factors

See Reference Table 1 for refinery combustion source factors.

Emission factors are provided for the estimation of combustion products with the exception of SO_2, for which the usually preferred RET is mass balance – based on the sulphur content of the fuel (see Example 1).

Emissions of certain trace elements can be estimated using mass balance, when fuel composition data is available. If such data is unavailable, default emission factors can be used.

Emissions of NO_x from oil and gas-fired boilers and furnaces that do not use CEMS for annual mass emissions can be calculated from the fuel burn and NO_x factors which have been agreed with us on a site specific basis.

(b)   Refinery process source factors

See Reference Table 1 for refinery process source factors.

Fuel analysis and process stream data

The use of fuel analysis and process stream data to determine emissions is similar to the use of emission factors.

The basic equation used, for example, in fuel analysis emission calculations is:

Equation 1

$$E = Q_f \times [\text{Op Hours}] \times (PC_f/100) \times (MW_p/EW_f)$$

Where:	E	Emission rate of pollutant (kg/yr)
	Q_f	Fuel/feedstock/raw material use (kg/hr)
	PC_f	Pollutant concentration in the fuel/feedstock/raw material (%)
	Op Hours	Operating hours per year (hr/yr)
	MW_p	Molecular weight of pollutant as emitted after combustion/processing
	EW_f	Elemental weight of pollutant as present in fuel/feedstock/raw material

Where the pollutant concentration in the fuel/feedstock/raw material is consistent over the averaging period (i.e. one year), Equation 1 can be rewritten as:

$$E = M \times [PC_f/100] \times (MW_p/EW_f)$$

Where:	E	Emission rate of pollutant (kg/yr)
	M	Mass of fuel/feedstock/raw material used in one year (kg/hr)
	PC_f	Pollutant concentration in the fuel/feedstock/raw material (%)
	MW_p	Molecular weight of pollutant as emitted after combustion/processing
	EW_f	Elemental weight of pollutant as present in fuel/feedstock/raw material

The following example shows how to estimate annual emissions using Equation 1.

Example 1

This example shows how SO_2 emissions can be calculated from oil combustion, based on fuel analysis results and fuel flow information. It is assumed that the facility operates using oil for 150 hours per year and that abatement of SO_2 does not occur.

Q_f	2000 kg/yr
PC_f	1.17%
MW_p	64
EW_f	32
Op Hours	1500 hr/yr
$E = Q_f \times PC_f \times (MW_p/EW_f) \times$ [Op Hours]	
$E = [(2000) \times (1.17/100) \times (64/32) \times 150]$ kg/yr	
$E = 7.02 \times 10^3$ kg/yr	

Equation 1 can also be used for volatile elements such as fluorine and chlorine as well as trace metallic pollutants, although some of these species are retained in the plant, either in the ash or in abatement equipment (see below).

When using Equation 1, you should be aware that the amount of pollutants present in the fuel or process stream can vary significantly.

2.1.3 Fugitive VOC emissions

For the purposes of this note fugitive VOC emissions from refineries can be split into four categories:

- Process fugitives;
- Tank farm fugitives;
- Loading/unloading fugitives; and
- Drainage and effluent system fugitives.

Guidance for estimation of the above releases for UK refineries can be found in two separate protocols produced by the Energy Institute. The first can be used to produce estimates of annual emissions of NMVOCs including fugitive VOC releases (VOC Protocol[1]) the second provides a methodology (Speciation Protocol[2]), in conjunction with total VOC releases, for determining the fractional speciation of hydrocarbon emissions from oil refineries.

(a)   Process fugitives

Two methods for calculating process fugitives are presented in the VOC Protocol.

The first method uses the USEPA protocol for equipment leak estimates[3]. This protocol assumes knowledge of the number of valves/flanges/seals on a refinery and takes a tiered approach to estimating emissions.

- Tier 1 applies average emission factors based upon the process service;
- Tier 2 applies average emission factors based on leak/no leak criteria. This requires the use of VOC monitoring equipment to measure threshold VOC concentrations at each fitting;
- Tier 3 applies emission correlations based on actual VOC concentration methods determined at each fitting.

---

[1] http://www.energyinstpubs.org.uk/pdfs/1643.pdf.
[2] http://www.energyinstpubs.org.uk/cgi-bin/search/advsearch.cgi?sessionid=1292859732&type=simple&searchstring=Speciation+Protocol&select=0&x=10&y=6
[3] http://www.epa.gov/ttnchie1/efdocs/equiplks.pdf

(i) Tier 1 – Average emissions factors

Where no screening values are available for particular equipment types, the "average emissions factors" presented in this section should be used. This methodology involves applying the following generic equation to estimate emissions from all sources in a stream, for a particular equipment type:

Equation 2

$$E = F \times WF \times N$$

Where:	E	The emission rate of VOC from all sources grouped in a particular equipment type and service (kg/hr) (e.g. values in light liquid service.)
	F	The average emission factor for the particular equipment type (from Table 2.3.)
	WF	The average weight fraction of VOC in the stream
	N	The number of pieces of equipment grouped in the relevant category according to equipment type, service and weight fraction of VOC

Although the average emission factors are in terms of VOCs, the equation still requires an input regarding the weight fraction of VOC in the process stream (i.e. WF) to account for any non-organic compounds. For example if the stream contains water vapour, you will need to account for this in your calculations. Example 2 illustrates the application of this methodology.

How to calculate your fugitive VOC emissions:

Step 1: Develop an inventory of the number and service type of fugitive sources

The number and service type (gas/vapour, light liquid and heavy liquid) of each equipment type in the refinery must be determined. Service type definitions are given below:

- Gas/vapour – material in a gaseous state under operating conditions;
- Light liquid – material in a liquid state in which the sum of the concentrations of individual constituents with a vapour pressure over 0.3 kilopascals (kPa) at 20°C $\geq$ 20% by weight (wt %); and
- Heavy liquid – material that does not fall under either of the above two definitions.

Step 2: Group the inventory into 'streams'

In order to simplify calculations, it is recommended that the equipment/service mode combinations identified in Step 1 (e.g. valves in gas service) be grouped into 'streams' according to the approximate weight fraction of VOCs (i.e. WF) in each stream.

A further simplification may be to group areas of the refinery according to the 'average' weight fraction of VOCs in the process streams. It will be necessary to take account of the various service modes for each equipment type (e.g. gas, light liquid etc) contained within that area.

Another approach may be to take the conservative assumption that all streams are approximately 100% VOCs, thereby making WF = 1.

Step 3: Note operational hours

For the specific equipment category defined by the above two steps, the number of operational hours needs to be estimated.

Step 4: Use emission factors to estimate emission rates

Use the relevant emission factors and the equation given above to calculate the emissions from each equipment type. These emissions should then be added to derive a total emission rate for all equipment pieces quantified using this methodology.

Table 3 gives the emission factors required to estimate emissions using the steps discussed above.

Table 2 – Average emission factors for process fugitives

Equipment type	Service	Emission factor (kg/hr/source)
Connectors	Gas	2.50×10^{-4}
	Light liquid	2.50×10^{-4}
	Heavy liquid	4.34×10^{-5}
Flanges	Gas	2.50×10^{-4}
	Light liquid	2.50×10^{-4}
	Heavy liquid	4.68×10^{-5}
Compressor seals	Gas	0.636
Pump seals	Light liquid	0.114
	Heavy liquid	3.49×10^{-3}
Valves	Gas	0.0268
	Light liquid	0.0109
	Heavy liquid	9.87×10^{-5}
Open-ended lines	All	2.30×10^{-3}
Pressure relief valves	Gas	0.16
Sampling connections	All	0.015
Other	Heavy liquid	5.18×10^{-5}
Note – the emission factors given above are for non-methane VOCs only.		

The following example shows the application of the average emission factor approach.

Example 2

A particular section of the refinery has 300 valves, 200 of these are in gas service (Step 1).
Within this smaller group of valves in gas service, it is ascertained that 100 valves are, on average, 80 weight percent NMVOCs, 10% methane, and 10% water vapour (Step 2).
It is estimated that this group of valves operates for 5500 hours per year (Step 3). The appropriate emission factor for valves in gas service is 0.0268 kg/hr/source (from Table 3) (Step 4).
Emissions from this group of valves is thus estimated by using the following parameters:
F = 0.0268
WF = 0.8
N = 100
The final emission estimate for the group of 100 valves specified above is approximately 11,900 kg of NMVOCs/year.
The above steps would then be repeated again for the remaining 200 valves that were not included in the above estimate for that section of the refinery. Similarly, emissions need to be calculated from other potential fugitive emission sources in that section, followed by the next refinery "section" and so on until fugitive emissions from the entire refinery have been quantified.

(ii)   Tier 2 – Leak/no-leak method
Screening using a portable monitoring device is required for this methodology. This method relies on a "leak"/"no-leak" criteria. The following steps should be taken.

Step 1: Measure leaks from fugitive sources

A leak is typically defined and recorded if a screening value of >10,000 ppmv is returned by an appropriate calibrated monitoring instrument. Therefore, the emission factor chosen from Table 3 will depend on whether the component tested returns a pass (i.e. reading $\geq$10,000 ppmv), or fail (i.e. reading <10,000 ppmv) result.

Step 2: Estimate the VOC emission rate

Emissions are estimated for each of the equipment types listed using the following equation:

Equation 3

E = (FG x NG) + (FL x NL)

Where:	E	The VOC emission rate for the equipment type (kg/hr)
	FG	The emission factor for sources with screening values ≥10,000 ppmv (kg/hr/source)
	NG	For the particular equipment type of concern, the number of sources with screening values ≥10,000 ppmv
	FL	The emission factor for sources with screening values <10,000 ppmv (kg/hr/source.)
	NL	For the particular equipment type of concern, the number of sources with screening values ≥10,000 ppmv

Step 3: Note operational hours

For the specific equipment pieces screened, the annual number of operational hours needs to be estimated. This is required to derive annual emissions based on the hourly emission rates.

Step 4: Determine total VOC emissions

If all process fugitive sources have been screened, total VOC emissions from all sources can be determined by adding emission rates from each individual equipment component.
Table 3 presents the emission factors required to estimate emissions using the steps discussed above.

Table 3 – Leak/no leak emission factors for process fugitives

Equipment type	Service	Leak (≥10,000 ppmv) emission factor (kg/hr)	No leak (<10,000 ppmv) emission factor (kg/hr)
Connectors/flanges	All	0.0375	0.00006
Valves	Gas	0.2626	0.0006
	Light liquid	0.0852	0.0017
	Heavy liquid	0.00023	0.00023
Pump seals	Light liquid	0.437	0.012
	Heavy liquid	0.3885	0.0135
Compressors	Gas	1.608	0.0894
Pressure relief valves	Gas	1.691	0.0447
Open-ended lines	All	0.01195	0.0015

(iii)   Tier 3 Correlation equations

This method can only be used if screening values (ppmv) are obtained through a fugitive leak screening programme. The required screening value (SV) data is collected using an appropriate calibrated monitoring instrument.

The following points are important to note when using this methodology:

- Emission estimates are for 'total organic carbon (TOC) and, as a consequence, a correction must be made to convert the estimates to NMVOCs (i.e. to exclude methane);
- These emission factors are on a 'per source' basis; and
- Each individual screening value must be entered into the correlation equation to predict emissions for an equipment piece. It is important not to average screening values and then enter the average value into the correlation equation to estimate emissions.

The following steps should be followed to determine fugitive emissions using the correlation equation approach.

Step 1: Measure leaks from fugitive sources

For each piece of equipment tested, the recorded screening value will fall into one of three categories. The correct estimation methodology must then be used for each category as follows:

1. For 'zero' readings (i.e. no emission detected), Step 2 should be consulted to estimate emissions;
2. For screening values between the lower and upper detection limits of the monitoring device, Step 3 should be used; and
3. For values greater than the upper detection limit of the monitoring device (i.e. a 'pegged' emission reading), Step 4 should be used.

Step 2: Use of zero default factors

If no emissions are detected (i.e. below detection limit), then the 'Default Zero Emission Rate' emission factors are used (see Table 5), unless the lower detection limit of the monitoring device is >1 ppmv. In this case, half the detection limit is used.

Step 3: Use of correlation factors to determine leak

If screening values (SV) are determined through testing (i.e. measured level is between the lower and upper detection limits), then the 'Correlation Equations' presented in Table 4 are to be used to determine the leak from each relevant component tested.

Step 4: Use of pegged emission rate

If pegged screening values are detected, the 'Pegged Emission Rate' emission factors presented in Table 4 are used.

Step 5: Correct TOC readings to VOC estimate

Once emissions have been estimated from each source, the emissions must be converted from TOCs to VOCs. To do this, additional information is required on the approximate weight % of VOCs and TOCs in the process streams from which the emissions originate. This is then combined with the emission estimate for each equipment component as follows:

Equation 4

$$E_{VOC} = E_{TOC} \times (WP_{VOC}/WP_{TOC})$$

Where:	E_{VOC}	The VOC emission rate from the equipment (kg/hr)
	E_{TOC}	The TOC emission rate from the equipment (kg/hr) calculated using the emission factors for correlations from Table 4
	WP_{VOC}	The concentration of VOC in the equipment in weight (%)
	WP_{TOC}	The concentration of TOC in the equipment in weight (%)

If a number of equipment pieces can be grouped because they share the same process stream and thus have similar VOC/TOC ratios, TOC emissions can be added for this equipment group prior to performing Step 5, thereby reducing the number of calculations required.

Step 6: Note operational hours

For the specific equipment pieces tested, you should estimate the annual number of operational hours. This information is required to derive annual emissions based on the hourly emission rates.

Step 7: Determine total VOC emissions

If all process fugitive sources have been tested, total VOC emissions from all sources can be determined by adding the emissions from each individual equipment component.

Table 4 – Correlation equations for process fugitive emissions

Equipment type	Default zero emission rate (kg/hr)	Pegged emission rate (kg/hr)		Correlation Equation (kg/hr)
		10,000 ppmv	100,000 ppmv	
Connector	7.5×10^{-6}	0.028	0.03	leak = 1.53×10^{-6} (SV)$^{0.735}$
Flange	3.1×10^{-7}	0.085	0.084	leak = 4.61×10^{-6} (SV)$^{0.703}$
Valve	7.8×10^{-6}	0.064	0.14	leak = 2.29×10^{-6} (SV)$^{0.746}$
Open-ended line	2.0×10^{-6}	0.03	0.079	leak = 2.20×10^{-6} (SV)$^{0.704}$
Pump seal	2.4×10^{-5}	0.074	0.16	leak = 5.03×10^{-5} (SV)$^{0.610}$
Other	4.0×10^{-6}	0.073	0.11	leak = 1.36×10^{-5} (SV)$^{0.589}$

The second method is a crude estimation which assumes that fugitive VOC emissions from plant and pipework represent 0.03wt% of the actual material processed in the refinery (including all thermally-processed material but not product blend stocks).

Thus annual process fugitives = 0.0003 x annual refinery throughput (tonnes).

This method should be used in the absence of available data on the number of valves, flanges, pump seals, etc. for the refinery under consideration.

(a)   Tank farm fugitives
    For a detailed coverage of estimation of emissions from both floating and fixed roof tanks refer to Section 2 of the VOC Protocol.

(b)   Loading/unloading fugitives
    For a detailed coverage of estimation of emissions from both controlled and uncontrolled loading operations refer to Section 3 of the VOC Protocol.

(d)   Drainage and effluent system fugitives
    For a more detailed coverage of estimation of emissions from drains, separators, air flotation units and biological treatment facilities refer to Section 1.9 of the VOC Protocol.

2.1.4 Speciation of VOC emissions

The VOC Speciation Protocol provides a methodology for determining the fractional speciation of hydrocarbon emissions from oil refineries. The results are reported as the mass fraction of the annual hydrocarbon emissions providing individual annual mass release data for the following SPRI substances:

- Benzene;
- Toluene;
- Xylene (all isomers);
- 1,3-butadiene;
- 1,2-dichloroethane; and
- 1,1,2,2-tetrachloroethane.

2.2 Emissions to water and wastewater

Water discharges from refinery processes can be contaminated by a variety of substances. The main ones and their main sources are illustrated in Table 5. This table should be taken as a guide only, and you should verify that there are no other pollutants emitted from the process.

Table 5 – Main water pollutants generated by refineries

Main water pollutants	Main sources
Phenols	Distillation units, visbreaker, catalytic cracking, ballast water
Organic chemicals (TOC)	Distillation units, hydro treatment, visbreaker, catalytic cracking, hydro cracking, spent caustic, storage tanks water heel drainings
Benzene, toluene, xylene (BTX)	Distillation units, hydro treatment, catalytic cracking, visbreaker, storage tanks water heel drainings

All of the following determinands in Table 6 below are generally measured directly from the effluent discharge unless otherwise indicated.

Table 6 – Determinands measured in refinery effluent discharges

Determinand measured in effluent discharge	Notes
Arsenic	
Benzene	API factor of 6μg/l applied to process water
Cadmium	
Chromium	
Copper	
Ethyl benzene	
Lead	
Mercury	
Nickel	
Nitrogen – Total	
Phenols	
Total organic carbon	
Toluene	API factor of 1μg/l applied to process water
Xylene	API factor of 0.25μg/l applied to process water
Zinc	

2.2.1 Emission sources

More generally, emissions to water arise from the following sources:

- Process water, steam and washwater. These waters become contaminated with process fluids, dissolved gases and apart from oil, will also have taken up hydrogen sulphide, ammonia and phenols. The process water is treated in several steps before discharge to the environment;
- Cooling water, once-through or circulating systems. This stream is theoretically free of oil. However, leakage into once-through systems, even at low concentrations, can result in significant mass losses because of the large volume of water involved;
- Rainwater from process areas. This type of water has not been in contact with the process fluids, but it comes from rainfall on surfaces which are possibly oil-contaminated. This water is typically treated prior to discharge to the environment.

The resulting discharge of the above substances depends on the 'in process' preventative measures (good housekeeping, re-use) and the presence and technical standards of wastewater treatment facilities.

2.3 Off-site waste transfers

2.3.1 Relevant wastes

The amount of waste generated by refineries is small if it is compared to the amount of raw materials and products that they process. Oil refinery waste normally covers three categories of materials:

- Oily and non-oily sludges. These originate from various sources such as crude and product tank bottoms, desalters, alkylation units, boiler feed water preparation, biotreaters, the cleaning of heat exchanger bundles and equipment, oil spills and soil remediation. In terms of volume oily sludges represent the largest waste category from refineries. Bio-sludge production only takes place if a refinery operates a biotreater;
- Other wastes are produced from many of the refining processes, petroleum handling operations and wastewater treatment. Both hazardous and non-hazardous wastes are generated. Spent catalysts originate from the reformers, catalytic crackers, hydro crackers, hydrodesulphurisation and hydro treating units; and
- Non-refining wastes; e.g. domestic, demolition and construction wastes.
- Any transfer of waste off-site to a third party is covered by the Duty of Care provisions of the Environmental Protection Act 1990. This includes the requirement to describe the waste and record the quantity. You should therefore use data generated in compliance with Duty of Care requirements to complete the SPRI return.
- If tankered waste is to be further processed, such as, dewatering of oily waste by a specialist waste contractor out with your site, it should be recorded within this Section.

Transboundary shipments of hazardous waste
For transboundary movements of hazardous waste (outwith the United Kingdom), the name and address of the recoverer or the disposer of the waste and the actual recovery or disposal site have to be reported.

2.4 Useful references

These are additional useful references relevant to this sector.

Protocol for the estimation of petroleum refinery process plant fugitive VOC emissions (The Energy Institute)

USEPA. Protocol for Equipment Leak Emission Estimates November 1995, 453/R-95-017

Reference Table 1 – UKPIA Pollution Inventory guidance for refineries

This guidance document was produced by UKPIA's Refinery Emissions Working Group and was developed through a review of relevant industry guidance; In particular, information from the US Environment Protection Agency's Air Chief program[4], the American Petroleum Institute[5] and the Canadian Petroleum Products Institute[6].

This document is designed to be an aid for compiling Pollution Inventory (PI) submissions from petroleum refineries, and covers the major categories of emission sources; process emissions, combustion emissions, wastewater, etc.

This table addresses all the pollutants which we consider potentially emitted from a typical oil refinery. For pollutants not contained within this table a return of "not applicable" is in most cases to be expected, to indicate that this pollutant is not knowingly discharged by the site.

Emissions to Air

Category 1: These emissions are almost certainly produced by refineries in volumes above the reporting threshold (i.e. returns are expected for these substances)					
Determinand	*Threshold (Kg)*	*Method[7]*	*Emission source*	*Reference*	*Factors and guidance*
Ammonia	1,000	C	FCCU Regen[8]	AP42	FCCU (uncontrolled): 0.155 kg/1000L
		C	SRU to stack[9]	Industry experience	1 ppm in SRU flue gas
		C	SWS to flare	Industry experience	Flared SWS gas x 0.002
CO	100,000	C	Combustion	AP42[10] AP42	RFG: 1.34 E^0 kg/1000m^3 (0.082 lb/MBTU) RFO: 6.00 E^{-1} kg/1000L (0.033 lb/MBTU)
		M	FCCU Regen	On-site analyser	Measurement
CO_2	10,000,000	C	Site combustion and process	EU ETS	Guidance from EU Commission and API – as part of EU ETS

---

[4] http://www3.epa.gov/airquality/emission.html
[5] http://www.api.org/Environment-Health-and-Safety
[6] http://www.capp.ca/
[7] In method column M=measurement, C=calculation, E=estimation (engineering judgement).
[8] When CO boiler is present NH_3 emissions from FCCU are considered negligible (see CPPI 9.3.4).
[9] Sour water stripper overhead gas to the sulphur recovery unit is included in this calculation.
[10] AP42: suggestion of formation in sulphur recovery unit but no mention of factors.

Category 1: These emissions are almost certainly produced by refineries in volumes above the reporting threshold (i.e. returns are expected for these substances)					
Determinand	**Threshold (Kg)**	**Method [7]**	**Emission source**	**Reference**	**Factors and guidance**
Chlorine[11]	10,000	E	Reformers	Industry experience	BRT from catalyst regeneration[12]
Dinitrogen oxide[13] (nitrous oxide)	10,000	C	Combustion	[EEA Corinair][14]	RFG: 2.16 E^{-2} kg/1000m^3 (22 g/million grams)
				AP42 AP42 AP42	NG (uncontrolled): 3.52 E^{-2} kg/1000m^3 NG (low-NO$_x$ burner): 1.02 E^{-2} kg/1000m^3 RFO: 1.32 E^{-2} kg/1000L
		E	Process	Industry experience	N/A (no longer applicable) for non-combustion plant
1,2 di-chloroethane	1,000	M	Site	IP Speciation Protocol	Based on speciation surveys
Hydrogen sulphide[15]	1,000	C	SRU to flare	CPPI	0.5% of measured H$_2$S content in gas flared (98% combusted, 1.5% reacted with CO)
Methane[16]	10,000	C	Combustion[17]	AP42	RFO (industrial boiler): 1.20 E^{-1} kg/1000L NG: 3.68 E^{-2} kg/1000m^3
		C	Fugitive	Industry experience	RFG flow x Me content x 0.03%
		C	FCCU regen	Industry experience	4.9 E^{-3} kg/1000m^3 exhaust gas flow
		C	Incomplete flare combustion	Industry experience	
NO$_x$	100,000	C	Combustion	EA	Site specific factors agreed for combustion plant

[11] Losses of free Cl from cooling towers (used as biocide) considered negligible on basis that Cl will be dissolved in water drops.
[12] Chlorine used in regeneration of catalyst (reactivation of active sites).
[13] It is anticipated that N$_2$O emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[14] http://www.eea.europa.eu/publications/emep-eea-guidebook-2013
[15] CPPI: "For process units which are subject to strict fugitive emission control, for example HF, the emissions may be considered negligible and assumed to be zero."
http://www.cppi.ca/tech/COPREI.pdf
[16] It is anticipated that CH$_4$ emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[17] Emission source is unburnt residuals in heater flue gases.

Category 1: These emissions are almost certainly produced by refineries in volumes above the reporting threshold (i.e. returns are expected for these substances)					
Determinand	Threshold (Kg)	Method [7]	Emission source	Reference	Factors and guidance
		C/M	FCCU regen	EA	Site specific EA agreed factors or emission analyzer
		C	FCCU regen	AP42	$2.04\ E^{-1}$ kg/1000L cracker feed
		C	Flare	Industry experience	0.068 lbs/MMBtu gas flared (HHV)
		C	SWS to flare (stoichiometric conversion of combusted ammonia to NO_x)	Industry experience	
Particulate matter	10,000	C	Combustion	AP42

AP42 | RFO: 1.1S + 0.39 kg/1000L (where S=%sulphur in fuel)
RFG/NG: $1.22\ E^{-1}$ kg/$1000m^3$ |
| | | M | FCCU regen[18] | BS 3504: 1983 | Continuous analyser or spot analysis |
| PM_{10} | 1,000 | C | Combustion | AP42 | RFO: 86% of total particulate
RFG/NG: 100% of total particulate |
			FCCU	CPPI	PM_{10}: 70% of total particulate
Sulphur oxides	100,000	C	Combustion	Industry experience	Fuel sulphur content x flow rate
		M	FCCU regen	EA	Continuous analyser or spot analysis
		C	FCCU regen	AP42	$1.41\ E^{0}$ kg/1000L of FCC feed
		C	SRU to stack	Industry experience	Based upon sulphur unit efficiency (% sulphur not removed)
		C	Flare	Industry experience	Flared gas sulphur content x flow rate

---

[18] CPPI "PM emissions from catalytic cracking units stem primarily from catalyst fines entrained in the exhaust gas from the catalyst regenerator."

Category 1: These emissions are almost certainly produced by refineries in volumes above the reporting threshold (i.e. returns are expected for these substances)					
Determinand	Threshold (Kg)	Method [7]	Emission source	Reference	Factors and guidance
Toluene	10	M/C	Site/Fugitive	IP speciation protocol	In-house data based on site speciation protocol
NMVOC	10,000	M/C	Site/Fugitive	IP estimation protocol	Modified by measured data as it becomes available from LDAR programmes
PAHs (Total)[19]	50	C	Combustion	API/WSPA	RFO: Sum of Borneff Six[20]: $1.39 \ E^{-6}$ kg/1000L NG: Sum of Borneff Six: $1.10 \ E^{-7}$ kg/1000m^3
		C	FCCU	CARB	$9.3 \ E^{-8}$ kg/1000L fresh feed ($6.71 \ E^{-6}$ lbs/MBar)
Benzo(a)pyrene	1	C	Combustion	AP42	RFO: $1.05 \ E^{-7}$ kg/1000L NG: $9.60 \ E^{-9}$ kg/1000m^3
		C	FCCU	CARB	$4.0 \ E^{-9}$ kg/1000L fresh feed ($2.60 \ E^{-7}$ lbs/MBar)
Benzene	1,000	M/C	Combustion	Industry experience	N/A (no longer applicable) for combustion plant
		M/C	Site/Fugitive	IP speciation protocol	Based upon site speciation survey
1,3-butadiene	100	M/C	Site/Fugitive	IP speciation protocol	Based upon site speciation survey
Butene	1,000	M/C	Site/Fugitive	IP speciation protocol	Based upon site speciation survey
Ethylene	1,000	M/C	Site/Fugitive	IP speciation protocol	Based upon site speciation survey
Pentene	1,000	M/C	Site/Fugitive	IP speciation protocol	Based upon site speciation survey
Propylene	10,000	M/C	Site/Fugitive	IP speciation protocol	Based upon site speciation survey

---

[17] Barnes, "UK Oil Refining and Atmospheric Emissions of Dioxins" (2004) and ENTEC, "Development of UKCost Curves for Abatement of Dioxin Emissions to Air" (2003)

[19] http://www.arb.ca.gov/app/emsinv/catef_form.html

[20] Borneff Six PAHs are; benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benzo(g,h,i)perylene, benzo(b)fluoranthene, benzo(k)fluoranthene and fluoranthene. From 2006 the SPRI Schedule requires reporting of the annual emissions of listed individual PAH compounds (with individual reporting thresholds) rather than a PAH total.

Category 1: These emissions are almost certainly produced by refineries in volumes above the reporting threshold (i.e. returns are expected for these substances)					
Determinand	**Threshold (Kg)**	**Method** [7]	**Emission source**	**Reference**	**Factors and guidance**
Tetrachloroethane	10	M/C	Site/Fugitive	IP speciation protocol	Based upon site speciation survey
Xylene	1,000	M/C	Site/Fugitive	IP speciation P Protocol	Based upon site speciation survey
Metals		C	Combustion	AP42	Combustion of RFO[17]
Nickel	10	C	Combustion	AP42	RFO: 1.01 E^{-2} kg/1000L
		C/M	FCCU	Industry experience	Cat cracker particulates x 584 ppm
Vanadium	10	C	Combustion	AP42	RFO: 3.82 E^{-3} kg/1000L
		C/M	FCCU	Industry experience	Cat cracker particulates x 1053 ppm
Zinc	100	C	Combustion	AP42	RFO: 3.49 E^{-3} kg/1000L

Category 2: These emissions may be produced by refineries but are generally below the reporting threshold. Further clarification may be required (i.e. further clarification may be required by reporting sites)					
Determinand	**Threshold (Kg)**	**Method** [21]	**Emission source**	**Reference**	**Factors and guidance**
Carbon Disulphide	1,000	E	SRU to stack[22]	Industry consensus	N/A or BRT
Hydrogen Chloride	1,000	E	Reformer	Industry experience	BRT from catalyst regeneration[23]
	10,000	E	Combustion	Industry experience	BRT[24]

---

[21] In method column M=measurement, C=calculation, E=estimation (engineering judgement).
[22] AP42: suggestion of formation in sulphur recovery unit but no mention of factors. http://www.epa.gov/ttnchie1/ap42/
[23] Chlorine used in regeneration of catalyst (reactivation of active sites).
[24] CPPI: "For process units which are subject to strict fugitive emission control, for example HF, the emissions may be considered negligible and assumed to be zero."

Determinand	Threshold (Kg)	Method	Emission source	Reference	Factors and guidance
Fluorine and inorganic compounds as HF	1,000	E	HF alkylation	HF detection equipment	BRT when undetected
HCFCs	1,000	C	Process refrigerants	Industry experience	Estimate from fridge units' make-up rate
Tetrachloroethylene	1	E	Site/Fugitive	Industry experience	Industry consensus BRT or N/A
Trichloroethylene	100	E	Site/Fugitive	Industry experience	Industry consensus BRT or N/A
Arsenic	1,000	C	Combustion	AP42	RFO: 1.58 E^{-4} kg/1000L
Mercury	1	C	Combustion	AP42	RFO: 1.36 E^{-5} kg/1000L
Selenium	100	C	Combustion	AP42	RFO: 8.20 E^{-5} kg/1000L
Category 3: These substances are unlikely to be produced by refineries (i.e. no returns are expected for these substances)					
Determinand	*Threshold (Kg)*	*Method* [25]	*Emission source*	*Reference*	*Factors and guidance*
Dioxins	0.00001	E	Combustion	IP/ENTEC	Industry consensus[26] indicates refineries not a source of dioxin emissions – assume BRT
Beryllium	1	C	Combustion	AP42	RFO: 3.34 E^{-6} kg/1000L

Substances listed in the SPRI Schedule but not included in these tables are considered to be not applicable to refinery emissions and *N/A* should be entered in the SPRI return.

Releases to the water environment and transfers in wastewater

Wherever possible data should be net of incoming cooling water quality, however where this would result in a negative return (i.e. removal of pollutants from incoming waters) a BRT return should be made.

Determinand	Threshold	Method	Emissions source	Reference	Factors and guidance
Category 1: These emissions are almost certainly produced by refineries in volumes above the reporting threshold (i.e. returns are expected for these substances)					
Determinand	*Threshold*	*Method* [27]	*Emissions source*	*Reference*	*Factors and guidance*
Benzene	10	M/C	Effluent treatment facilities		Effluent quality measured data – BRT if bio-treated

---

[25] In method column M=measurement, C=calculation, E=estimation (engineering judgement).
[26] Barnes, "UK Oil Refining and Atmospheric Emissions of Dioxins" (2004) and ENTEC, "Development of UK Cost Curves for Abatement of Dioxin Emissions to Air" (2003).
[27] In method column M=measurement, C=calculation, E=estimation (engineering judgement).

Determinand	Threshold	Method [27]	Emissions source	Reference	Factors and guidance
		C	Process water	API	6 μg/litre process water
Toluene	10	M/C	Effluent treatment facilities		Effluent quality data
		C	Process water	API	1 μg/litre process water
Xylene	10	M/C	Effluent treatment facilities		Effluent quality data
		C	Process water	API	0.25 μg/litre process water
Nitrogen	50,000	M	Effluent treatment facilities		Effluent quality data (14/17 since ammoniacal)
Phenols	20	M	Effluent treatment facilities		Effluent quality data (72/94 for "as C")
TOC	50,000	M	Effluent treatment facilities		Effluent quality data
Arsenic	5	M	Effluent treatment facilities		Effluent quality data
Cadmium	1	M	Effluent treatment facilities		Effluent quality data
Chromium	20	M	Effluent treatment facilities		Effluent quality data
Copper	20	M	Effluent treatment facilities		Effluent quality data
Lead	20	M	Effluent treatment facilities		Effluent quality data
Mercury	0.1	M	Effluent treatment facilities		Effluent quality data
Nickel	20	M	Effluent treatment facilities		Effluent quality data
Zinc	100	M	Effluent treatment facilities		Effluent quality data

Category 1: These emissions are almost certainly produced by refineries in volumes above the reporting threshold (i.e. returns are expected for these substances)

Substances listed in the SPRI Schedule but not included in these tables are considered to be not applicable to refinery emissions and *N/A* should be entered in the SPRI return.

3   Incineration sector guidance

This section covers activities that are regulated as "Incineration and co-incineration of waste" under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended; PPC Regulations). Included within the scope are Part A prescribed/listed activities regulated under Chapter 5, Section 5.1 of the PPC Regulations. SPRI guidance for co-incineration installations such as combustion (e.g. power stations) and cement plants is covered in the appropriate Section of this Guidance Note.

For the purposes of this note, activities can be broadly separated into two categories; Waste incineration and non-waste incineration activities. Plants excluded from waste incineration categorisation include those burning only vegetable waste from agriculture and forestry, wood waste, animal carcasses and radioactive waste amongst others. These excluded plants are not subject to waste incineration mandatory monitoring requirements if it has been demonstrated in the PPC application that it was not Best Available Techniques (BAT) so to do. Essentially, the waste incinerators covered in this note are; Municipal Waste Incinerators (MWI), Clinical Waste Incinerators (CWI), Hazardous (Chemical) Waste Incinerators (HWI), Sewage Sludge Incinerators (SSI), Drum Incinerators (DI) and Animal Remains Incinerators (ARI).

3.1   Air emissions

Incineration installations subject to the Industrial Emissions Directive (IED) are normally required to be continuously monitored for NO_x (provided that ELVs are set), total particulate matter, CO, TOC, HCl, HF and SO_2. Under certain circumstances, continuous monitoring of HF, HCl and SO_2 may not be required and periodic monitoring can be substituted. The specific requirements for continuous or periodic monitoring are laid down in the PPC permit. The permit also specifies frequencies for periodic monitoring for heavy metals, dioxins and furans, dioxin-like PCBs and PAHs. The frequencies required by the IED are the minimum frequencies for such periodic measurements, but the permit may specify higher frequencies. Additionally, the permit may set additional site-specific monitoring requirements depending upon the local circumstances, which may include, where Selective Non-catalytic Reduction (SNCR) abatement is in operation, N_2O and/or NH_3 releases depending on the reductant used.

The main air emissions from waste incineration activities are shown in Table 7. The table should be taken as a guide only, and you should verify that there are no other pollutants emitted from your installation. See Reference Table 2 for a summary of currently used RETs and guidance on a more comprehensive list of potential releases of substances to air from various sources.

Table 7 – Main air pollutants emitted by incineration activities and their main sources

Main air pollutants	Main sources
Cd	Flue gas in MSW incinerators from batteries, accumulators, paints and plastics. Hazardous wastes including effluent treatment sludges and drummed waste from metal plating works.
CO	Flue gas as a result of incomplete combustion of waste; e.g. if spontaneously evaporating or rapid-burning substances are present, or when combustion gas mixing with the supplied oxygen is poor.
CO_2	Flue gas as a result of complete combustion of organic material. Between 0.7 and 1.7 tonnes of CO_2 is generated per tonne of MSW combusted.
Dioxins & furans	Flue gas as a result of re-combination reaction of carbon, oxygen and chlorine. Also found in boiler ash, bottom ash, fly ash and sorbents.
HCl	Flue gas from wastes containing chlorinated organic compounds or chlorides.
HF	Flue gas from fluorinated plastic or fluorinated textiles in MSW and a variety of fluorinated compounds in HWI.
Hg	Flue gas from MSW containing batteries, thermometers, dental amalgam, fluorescent tubes or mercury switches. In HWI from coking plant tars, waste from chlorine alkaline electrolysis, caustic oil sludge from refineries and other chemicals containing mercury. Also found in bottom ash, fly ash and sorbents. In SSI, Hg from sewage (especially dental amalgam).

Main air pollutants	Main sources
Metals (Heavy metals and compounds other than Hg and Cd) Sb, As, Pb, Cr, Cu, Mn, Ni, V and Zn.	Flue gas as particulate matter usually as metal oxides and chlorides. Also found in bottom ash, fly ash and sorbent.
NH_3	Flue gas where SNCR is used and NH_3 is used as a reducing agent. This arises through overdosing.
NO_x	Flue gas as both thermal and fuel NO_x. In MSW incinerators the proportion of thermal NO_x is very relevant with each type of grate having an inherent background NO_x level. It is often more significant than fuel NO_x.
N_2O	Principally from SNCR. Modern MSW incinerators have low combustion-originated N_2O but, depending on reagent, significant emissions resulting from SNCR.
PAHs	Flue gas as products of incomplete combustion. Also found in bottom ash, fly ash and sorbents.
Dioxin-like PCBs	Flue gas from most municipal waste streams and some industrial wastes. Higher concentrations in some hazardous waste streams. Also found in bottom ash and APC residues.
Particulate matter (including PM_{10})	Flue gas as fine ash from the incineration process entrained in the gas flow. Also fugitive releases of dust from waste storage areas.
SO_2	Flue gas where sulphur is present in the waste stream. Common sources of sulphur in some waste streams are: waste paper; plaster board (calcium sulphate) and sewage sludges.
VOCs	Flue gas from incineration of organic waste. Also fugitive releases from waste storage areas.
Note – The term incineration includes hazardous waste, clinical waste, municipal, animal carcass and sewage sludge incineration.	

3.1.1 Emissions sources

These emissions are exhausted via a stack or vent; i.e. a single point source into the atmosphere. Abatement equipment; e.g. scrubbing units, fabric filters (bag house) can be incorporated into the exhaust system prior to discharge to atmosphere. Point source (main stack) emissions are usually the most significant emission source (in terms of annual mass releases) for combustion activities taking place within a variety of furnace types at incineration activities.

3.1.2 Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack.

Fugitive dust and VOC emissions will be minimised where combustion, flue gas treatment processes and plant in general (including storage areas) operate at negative pressure.

Some examples of the potential sources of fugitive emissions to air are:

- The loading and unloading of transport containers;
- Storage areas (e.g. bays, stockpiles, etc.);
- Transferring material between vessels (e.g. silos, volatile liquids such as SLF);
- Conveyor systems;
- Pipe work and ductwork systems (e.g. pumps, valves, flanges);
- Abatement equipment by-pass;
- Accidental loss of containment from failed plant and equipment;
- Oil and ammonia storage tanks;
- Poor building containment and extraction;
- Use of poorly-sealed waste charging systems.

Only fugitive emissions that leave the installation need to be reported to the SPRI. Whilst contained spills would therefore not need to be reported, you should report vapour emissions that may have dispersed.

Waste feedstock analysis and process stream data

The use of waste feedstock analysis and process stream data to determine emissions is similar to the use of emission factors.

For MSW incineration, analysis of fuel is not used for calculation of emissions. Either analysis is not carried out, is too variable, is too unreliable or cannot be related to emissions.

The basic equation used, for example, in waste feedstock analysis emission calculations is the same as Equation 1 and should be used in the same way (as illustrated in Example 1):

Equation 1 can also be used for volatile elements such as fluorine and chlorine as well as trace metallic pollutants, although some of these species are retained in the plant, either in the ash or in abatement equipment and appropriate retention factors applied.

When using Equation 1, you should be aware that the amount of pollutants present in the waste feedstock or process stream can vary significantly.

Fugitive emissions

Methodologies and factors used to determine fugitive emissions are referenced in Reference Table 2.

3.2   Emissions to water and wastewater

Water discharges from incineration processes arise from the air abatement equipment (e.g. wet scrubbers), storm water, cooling water, boiler blow-down, incoming waste handling areas, ash and other residue handling areas, accidental emissions of raw materials, products or waste materials, firefighting and from on-site effluent treatment. Table 8 illustrates the main pollutants emitted to water and their main sources. The table should be taken as a guide only, and you should verify that there are no other pollutants emitted from the process, including in association with suspended particulate matter. See Reference Table 2 for methodologies used to determine emissions to water.

Table 8 – Main water pollutants generated by incineration activities

Main water pollutants	Main sources
Dioxins and Furans	Scrubber liquor, releases from ash quenching.
Ethylene dichloride	Scrubber liquor, releases from ash quenching.
Metals	Waste storage, scrubber liquor, releases from ash quenching.
PAHs	Scrubber liquor, releases from ash quenching.
Suspended solids	Raw material preparation, storage and handling, scrubber liquor, releases from ash quenching.
TOC	Waste storage, scrubber liquor, releases from ash quenching.
Note – At some installations wastewater will pass through an on-site ETP prior to discharge into the water environment.	

The resulting discharge of the above substances depends on the 'in process' preventative measures (e.g. good housekeeping, re-use) and the presence and technical standards of wastewater treatment facilities.

Notwithstanding the above, you should consider all emission sources to water and characterise the flows and emission concentrations from each source.

3.3   Off-site waste transfers

3.3.1   Relevant wastes

In general the waste streams from incineration facilities comprise:

- Bottom ash (approx. 25% by weight and 10% by volume of input for a modern MWI);
- Fly ash:
- APC residues (commonly combined with fly ash and then approx. 2.5% by weight of waste input for a modern MWI);
- Rejected feedstock wastes (chemical or physical incompatibility e.g. large objects);
- Recovered waste fractions; e.g. steel and aluminium extracted from ash.
- Road tanker waste removed from the site during the reporting year.

Transboundary shipments of hazardous waste

For transboundary movements of hazardous waste (out with the United Kingdom), the name and address of the recoverer or the disposer of the waste and the actual recovery or disposal site have to be reported.

Reference Table 2 – Incineration source factors

This Table is designed to be an aid for compiling SPRI submissions from incineration processes, and covers the major categories of emission sources; combustion emissions, fugitive emissions, wastewater, etc. It also includes emission factors where applicable.

The table below addresses all the pollutants which we consider potentially emitted from typical incineration processes. For pollutants not contained within this table a return of No Longer Applicable (N/A) is in most cases to be expected, to indicate that this pollutant is not knowingly discharged by the site. Where a site is reporting for the first year non-relevant pollutants will have to be deleted within the electronic form.

Emissions to Air

Determinand	Method[28]	Emission source	Literature reference	Factors and guidance
Benzene	C	Waste Combustion		
Benzo(a)pyrene	M	Waste Combustion	BS ISO 11338	BS ISO 11338 for extractive monitoring.
Butadiene	C	Waste Combustion		
CO	M	Waste Combustion	CEN/ISO/ MCERTS	Continuous and periodic monitoring carried out for all incinerators covered by IED. BS EN14181 for CEMS. Standard Reference Method BS EN15058. (ISO12039) formerly relevant.
	C	MSW Combustion	Environment Agency (2000)	0.197 kg/t of MSW combusted.
	C	SSW Combustion	USEPA 1995	1.1 kg/t of SSW combusted (fluidised bed).
			USEPA 1995	15.5 kg/t of SSW combusted (multiple hearth).
	C	CW Combustion	USEPA 1995	1.48 kg/t of CW combusted (controlled air).
CO_2	C	Waste Combustion	EU ETS M&R Methodology (2004/156/EC)	Although incinerators are not subject to the EU ETS requirements the EU ETS methodology is considered best practice.
CH_4[29]	C	MSW Combustion	Environment Agency (1997)	0.0008 kg/t of MSW combusted.
	C	SSW Combustion	USEPA 1995	0.39 kg/t of SSW combusted in multiple hearth (controlled).
Dioxins and Furans	M	Waste Combustion	BS EN1948	Periodic monitoring required for IED incinerators.
HCl	M	Waste Combustion	MCERTS/BS EN	BS EN14181 for CEMs and BS EN1911 (or demonstrated equivalent) for periodic monitoring carried out for all incinerators covered by IED.
	C	MSW Combustion	USEPA 1996	3.2 Kg/t of MSW combusted.
	C	SSW Combustion	USEPA 1995	0.05 Kg/t of SSW combusted on fluidised bed (controlled).
	C	CW Combustion	USEPA 1995	16.8 Kg/t of CW combusted (uncontrolled).
Fluorine and inorganic compounds – as HF	M	Waste Combustion	ISO/USEPA	BS EN14181 for CEMs and USEPA Method 26A for periodic monitoring. Not all IED incinerators are required to monitor HF continuously.

[28] In method column M=measurement, C=calculation, E=estimation (engineering judgement).
[29] Option exists for CH_4 emissions to be included in future phases of the EU ETS – estimation methodologies may warrant re-evaluation when EU monitoring and reporting decisions are published.

Determinand	Method[28]	Emission source	Literature reference	Factors and guidance
NH_3	M	SNCR NO_x abatement	MCERTS certified equipment	Continuous or periodic monitoring may be required depending upon BAT assessment. US EPA Method 26. VDI 2461 or ASTM D6348-03 potentially relevant to periodic monitoring.
NMVOCs	M	Waste Combustion	MCERTS/BS EN 12619	CEM and extractive monitoring required under IED. BS EN14181 for CEMS.
	C	MSW Combustion	Environment Agency (2000)	0.0308 kg/t of MSW combusted.
	C	SSW Combustion	USEPA 1995	0.84 kg/t of SSW combusted in multiple hearth (uncontrolled).
	C	Fugitive VOC Releases		
NO_x	M	Waste Combustion	CEN/ISO/MCERTS	Continuous monitoring carried out for all incinerators covered by IED. BS EN14181. Standard Reference Method BS EN14792. (BS ISO 10849 for CEM & BS ISO 11564/ISO 10849 for extractive monitoring of former relevance.
	C	MSW Combustion	Environment Agency (2000)	1.37 kg/t of MSW combusted.
	C	SSW Combustion	USEPA 1995	2.5 kg/t of SSW combusted in multiple hearth (uncontrolled).
	C	SSW Combustion	USEPA 1995	0.88 kg/t of SSW combusted in fluidised bed (uncontrolled).
	C	CW Combustion	USEPA 1995	1.78 kg/t of CW combusted in controlled air (uncontrolled).
N_2O[30]	M	Waste Combustion		Extractive monitoring required for IED. (ASTM D6348-03, ISO 10849, VDI2469-1).
	C	MSW combustion	IPCC (2000)	0.03 kg/t of MSW combusted.
	C	SSW combustion	IPCC (2000)	0.8 kg/t of SSW combusted.
PAHs[31]	M	Waste Combustion	BS ISO	BS ISO11338 for extractive monitoring.
PCBs	M	Waste Combustion	CEN/BS EN	BS EN1948 for dioxin-like PCBs extractive monitoring.
Total Particulate Matter	M	Waste Combustion	BS ISO/BS EN	Continuous monitoring carried out for all incinerators covered by IED. BS EN13284-2 for CEMs and BS EN13284-1 SRM.
	C	MSW Combustion	USEPA 1996	12.6 kg/t of MSW combusted (uncontrolled).
	C	SSW Combustion	USEPA 1995	233 kg/t of SSW combusted (uncontrolled).
	C	CW Combustion	USEPA 1995	2.33 kg/t of CW combusted (uncontrolled).

[30] Option exists for N_2O emissions to be included in future phases of the EU ETS – estimation methodologies may warrant re-evaluation when EU monitoring and reporting decisions are published.
[31] From 2006 the SPRI requires reporting of the annual emissions of listed individual PAH compounds (with individual reporting thresholds) rather than a PAH total.

Determinand	Method[28]	Emission source	Literature reference	Factors and guidance
PM$_{10}$ (also PM$_{2.5}$)	C	MSW Combustion	(Environment Agency 2000)	0.022 kg/t of MSW combusted.
	C	SSW Combustion		0.075 kg/t of SSW combusted.
	C	CW Combustion	CORINAIR (1999)	0.27 kg/t of CW combusted.
SO$_x$	M	Waste Combustion	CEN/ISO/MCERTS	BS EN14181/BS 6069 (ISO 7935) for CEMs and BS EN14791 (SRM). BS ISO11632/BS ISO 6069 alternatives for extractive monitoring.
	C	MSW Combustion	(EA 2000)	0.076 kg/t of MSW combusted
	C	SSW Combustion	USEPA 1995	2.3 kg/t of SSW combusted in multiple hearth (venturi scrubber)
	C	SSW Combustion	USEPA 1995	0.15 kg/t of SSW combusted in fluidised bed (uncontrolled)
	C	CW Combustion	USEPA 1995	1.09 kg/t of CW combusted in controlled air (uncontrolled)
Metals				
As	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Cd	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Cu	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Cr	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Hg	M	Waste Combustion	BS EN	BS EN13211 for extractive monitoring (or in series with other metals by BS EN14385 subject to adaptation).
Mn	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Ni	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Pb	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Sb	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
V	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.
Zn	M	Waste Combustion	BS EN	BS EN14385 for extractive monitoring.[32]

---

[32] Although not specifically validated for zinc BS EN14385 will be applicable in most cases (see Environment Agency for England and Wales "Metals" Method Implementation Document).

Releases to the water environment and transfers in wastewater

Wherever possible data should be net of incoming cooling water quality, however where this would result in a negative return (i.e. removal of pollutants from incoming waters) a no longer applicable (N/A) return should be made unless alternative local arrangements have been made with us.

The list of reference methods is not exhaustive, other analytical methods may be appropriate.

Determinand	Method	Emissions Source	Literature Reference	Factors and Guidance
As	M	Effluent Treatment Facilities	BS EN ISO 11969	Monthly flow proportional sampling.
Cd	M	Effluent Treatment Facilities	BS EN ISO 17294	Monthly flow proportional sampling.
Chlorides (as total Cl)	M	Effluent Treatment Facilities	Chloride in Waters. Sewage and Effluents 1981 SCA blue book.	
Chloroform	M	Effluent Treatment Facilities	BS EN ISO 10301	
Cr	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling.
Cu	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling.
Ethylene dichloride	M	Effluent Treatment Facilities	BS EN ISO 10301	
Hg	M	Effluent Treatment Facilities	BS EN 13506	Monthly flow proportional sampling.
Naphthalene	M	Effluent Treatment Facilities	BS ISO 17993 USEPA Method 0610	
Ni	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling.
PAHs[33]	M	Effluent Treatment Facilities	BS ISO 17993 USEPA method 0610	
Pb	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling.
PCBs	M	Effluent Treatment Facilities	USEPA methods 0680, 1668	
TOC	M	Effluent Treatment Facilities		Continuous monitoring.
Tributyltin	M	Effluent Treatment Facilities	BS ISO 18073:2004	
Zinc	M	Effluent Treatment Facilities	BS EN ISO 11885 BS EN ISO 17294	Monthly flow proportional sampling.

---

[33] Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene.

4　Paper and wood production and processing sector guidance

This Note covers activities that are regulated as "Paper, pulp and panel manufacturing" under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended; PPC Regulations). Included within the scope are Part A prescribed/listed activities regulated under Chapter 6, Section 6.1 of the PPC regulations. SPRI guidance for combustion activities carried out at paper and wood production and processing installations is covered in the appropriate Section of this Guidance Note.

4.1　Air emissions

4.1.1　Relevant pollutants

The main air emissions from paper and pulp activities are shown in Table 9. The table should be taken as a guide only, and you should verify that there are no other pollutants emitted from your installation.

Table 9 – Guide to main pollutants emitted by paper and wood production and processing activities to air

Main air pollutants	Main sources	
	Paper	**Pulp**
CH_4	Effluent treatment plant.	Effluent treatment plant.
Chloroform	Bleaching, effluent treatment plant.	Recycled fibre pulping and de-inking, bleaching with chlorine dioxide or sodium hypochlorite.
CO	Papermaking, effluent treatment plant.	
CO_2	Effluent treatment plant.	Neutral sulphite semi-chemical, with recovery. Effluent treatment plant.
Dioxins and furans		Neutral sulphite semi-chemical, with recovery.
Formaldehyde	From resins used in papermaking.	
NO_x	Effluent treatment plant.	Neutral sulphite semi-chemical, with recovery. Effluent treatment plant.
PAHs		Neutral sulphite semi-chemical, with recovery. Effluent treatment plant.
PM	Finishing/converting operations.	Neutral sulphite semi-chemical, with recovery.
SO_x		Neutral sulphite semi-chemical, with recovery. Neutral sulphite semi-chemical, without recovery. Sulphite without recovery, unbleached.
VOCs	Drying processes.	
Note – Combustion process releases are not covered in this table.		

4.1.2　Emission sources

These emissions are exhausted via a stack or vent, i.e. a single point source into the atmosphere. Abatement equipment, e.g. cyclones for removal of PM can be incorporated into the exhaust system prior to discharge to atmosphere.

4.1.3　Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack. Fugitive emissions are not considered to be significant in the paper and wood production and processing industry.

Some examples of the potential sources of fugitive emissions to air are:

- Storage areas (e.g. bays, stockpiles, lagoons, etc.);
- Transferring material between vessels;
- Conveyor systems;
- Pipe work and ductwork systems (e.g. pumps, valves, flanges);
- Abatement equipment by-pass;
- Accidental loss of containment from failed plant and equipment;
- Open vessels (in particular the effluent treatment plant);
- Spillages; and
- Poor building containment and extraction.

Only fugitive emissions that leave the installation need to be reported to the SPRI. Whilst contained spills would therefore not need to be reported, you should report vapour emissions that may have dispersed.

4.2 Emissions to water and wastewater

4.2.1 Relevant pollutants and emission sources

A variety of substances are present in water discharges from paper and wood production and processing activities (with some residual organic constituents of the effluent not known in detail). Table 10 illustrates the main pollutants emitted to water and their main sources. Not all of these are SPRI-reportable substances, but you need to take account of any reportable substances emitted in association with them (for example, metal contents incorporated with total suspended solids). The table should be taken as a guide only, and you should verify that there are no other reportable substances emitted from the process.

Table 10 – Main water pollutants generated by and wood production and processing activities

Main water pollutants	Main sources	
	Paper	Pulp
Alcohols/Acids	Papermaking.	Pulping processes.
Cadmium	Papermaking.	Pulping processes, bleaching.
Chloroform		Bleaching, RCF pulping & de-inking.
Defoamers	Papermaking.	RCF pulping & de-inking.
Formaldehyde	Papermaking.	
Heavy Metals	Papermaking.	Pulping processes, bleaching.
Mercury	Papermaking.	Pulping processes, bleaching.
Ammonia	Papermaking, effluent treatment.	
PM/TSS	Papermaking.	Pulping processes, bleaching.
Pentachlorophenol	Papermaking.	RCF pulping & de-inking.
Phosphates/Nitrates	Papermaking, effluent treatment.	Pulping processes.
SOx		Mechanical pulping with no recovery.
Sulphides	Papermaking, effluent treatment.	RCF pulping & de-inking, mechanical pulping.
Sulphites & Sulphates	Papermaking.	RCF pulping & de-inking, mechanical pulping.
Surfactants	Papermaking.	RCF pulping & de-inking.
Wood organics	Papermaking.	Pulping processes, bleaching.

The resulting discharge of the above substances depends on the 'in-process' preventative measures (e.g. good housekeeping, re-use) and the presence and technical standards of wastewater treatment facilities.

Notwithstanding the above, you should consider all emission sources to water and characterise the flows and emission concentrations from each source.

4.3   Off-site waste transfers

4.3.1   Relevant wastes

In general the waste streams from paper and pulp facilities comprise the following (EWC codes for specific waste streams are shown in brackets for convenience):

- Green liquor sludge – from recovery of cooking liquor (EWC Code 03 03 02);
- Mechanically-separated rejects from pulping of waste paper and cardboard (EWC 03 03 07);
- De-inking sludges from paper recycling (EWC 03 03 05);
- Wastes from sorting of paper and cardboard destined for recycling (EWC 03 03 08);
- Fibre rejects, fibre-, filler- and coating-sludges from mechanical separation (EWC 03 03 10);
- Sludges from on-site effluent treatment (EWC 03 03 11);
- General inert industrial waste;
- Waste bark and wood (EWC Code 03 03 01).
- Road tanker waste removed from the site during the reporting year.

Transboundary shipments of hazardous waste
For transboundary movements of hazardous waste (out with the United Kingdom), the name and address of the recoverer or the disposer of the waste and the actual recovery or disposal site have to be reported.

5   Cement and lime sector guidance

This Note covers activities that are regulated as "Production of cement, lime and magnesium oxide" under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended; PPC Regulations). Included within the scope are Part A prescribed/listed activities regulated under Chapter 3, Section 3.1 of the PPC Regulations. SPRI guidance for combustion activities carried out at cement, lime and magnesium oxide and processing installations is covered in the appropriate Section of this Guidance Note.

5.1   Air emissions

5.1.1   Relevant pollutants

The main air emissions from cement and lime production activities are shown in Tables 11, 12 and 13 respectively. The tables should be taken as a guide only, and you should verify that there are no other pollutants emitted from your process. See Annexes 1 and 2 for a summary of currently used RETs and guidance for releases of substances to air from various sources.

Table 11 – Main air pollutants emitted by cement and related activities and their release points

Main air pollutants	Release point
CO	Kiln exhaust gas.
CO_2	Kiln exhaust gas.
Dioxins and furans	Kiln exhaust gas.
HCl	Kiln exhaust gas.
Fluorine and inorganic compounds – as HF	Kiln exhaust gas.
NO_x	Kiln exhaust gas.
Particulate matter (including PM_{10})	Kiln exhaust gas, other point sources and fugitive sources (smaller bag filters) such as raw material preparation, handling and storage, fuel preparation, handling and storage, kiln, cooler, cement milling, product handling and storage.
SO_2	Kiln exhaust gas.
NMVOCs	Kiln exhaust gas, fugitive sources from fuel preparation, handling and storage.
Metals	Kiln exhaust gas (semi-volatile/volatile metals only).

Table 12 – Main air pollutants emitted by lime and related activities and their release points (gas-fired kilns)

Main air pollutants	Release point
CO	Kiln exhaust gas.
CO_2	Kiln exhaust gas.
NO_x	Kiln exhaust gas.
Total particulate matter (including PM_{10})	Kiln exhaust gas, other point sources and fugitive sources such as raw material preparation, handling and storage, fuel preparation, handling and storage, kiln, hydrator, product handling and storage.
SO_2	Kiln exhaust gas.

Table 13 – Main air pollutants emitted by lime and related activities and their release points (where fuels other than gas are used)

Main air pollutants	Release point
Dioxins and furans	Kiln exhaust gas.
HCl	Kiln exhaust gas.
Fluorine and inorganic compounds – as HF	Kiln exhaust gas.
Metals	Kiln exhaust gas.
NMVOCs	Kiln exhaust gas, fuel preparation, handling and storage.

5.1.2 Emissions sources

These emissions are exhausted via a stack or vent; i.e. a single point source into the atmosphere. Abatement equipment; e.g. scrubbing units, fabric filters (bag house) can be incorporated into the exhaust system prior to discharge to atmosphere. Point source (main stack) emissions will normally be the most significant emission source (in terms of annual mass releases) for combustion activities taking place within kilns and clinker coolers at cement and lime production sites.

5.1.3 Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack.

Some examples of the potential sources of fugitive emissions to air are:

- External stockpiled materials;
- Transferring material between vessels;
- Uncovered conveyor systems;
- Pipework and ductwork systems (e.g. pumps, valves, flanges);
- Accidental loss of containment from failed plant and equipment;
- Packing plant;
- Spillages; and
- Ancillary bag filters.

5.1.4 Emission factors

Cement process emission factors
Refer to Reference Table 3 for cement production source emission factors provided by the British Cement Association (BCA).

Lime process emission factors
Refer to Reference Table 4 for lime process source factors.

5.2 Emissions to water and wastewater

5.2.1 Relevant pollutants and emission sources

Water discharges from cement and lime processes arise from storm water, from cooling water, from accidental emissions of raw materials, products or waste materials and from firefighting resulting from industrial accidents. Table 14 illustrates the main pollutant emitted to water and its main sources. Suspended solids alone are not an SPRI-reportable substance. However, the table should be taken as a guide only, and you should verify that there are no other substances discharged from the process, including in association with suspended particulate matter.

Table 14 – Main water pollutants generated by cement and lime and related activities

Main water pollutants	Main sources
Suspended solids	Raw material preparation, storage & handling.

Discharge of substances depends on the 'in-process' preventative measures (good housekeeping, re-use) and the presence and technical standards of wastewater treatment facilities.

Notwithstanding the above, you should consider all emission sources to water and characterise the flows and emission concentrations from each source.

5.3   Off-site waste transfers

5.3.1   Relevant wastes

In general the waste streams from cement and lime production comprises:

- Cement and lime kiln dust collected in particulate abatement devices;
- Materials arising from process clean-outs;
- Spent kiln-liner and refractory bricks;
- Waste oils and lubricants;
- Chemical containers and general inert industrial waste; and
- By-pass dust (cement works).

Transboundary shipments of hazardous waste
For transboundary movements of hazardous waste (outwith the United Kingdom), the name and address of the recoverer or the disposer of the waste and the actual recovery or disposal site have to be reported.

Reference Table 3 – Cement source factors

This Reference Table is designed to be an aid for compiling SPRI submissions from cement production processes, and covers the major categories of emission sources; process emissions, combustion emissions, fugitive emissions, wastewater, etc. It also includes emission factors where applicable.

The table below addresses all the pollutants which we consider likely to be reported from typical cement production processes. For pollutants not contained within this table a return of not applicable, N/A, is in most cases to be expected, to indicate that this pollutant is not knowingly discharged by the site.

Emissions to air

Determinand	Method[34]	Emission Source	Reference	Factors and guidance
CO	M/C	Cement kiln	BCA 2004	1.94 kg/te of clinker produced.
CO_2[35]	C	Site combustion and process sources	EU ETS	Guidance from European Commission – as part of EU ETS[36].
CH_4[37]	C	Cement kiln	BCA 2004	0.036 kg/te of clinker produced.
Dioxins and furans	M/C	Cement kiln	BCA 2004	2×10^{-9} kg TEQ/te of clinker produced.
HCl	M/C	Cement kiln	BCA 2004	2.3×10^{-2} kg/te of clinker produced.
Fluorine and inorganic compounds – as HF	M/C	Cement kiln	None	None.
NH_3	M/C	Cement kiln	BCA 2004	1.4×10^{-2} kg/te of clinker produced.
NMVOCs	M/C	Cement kiln	BCA 2004	0.1 kg/te of clinker produced.
NO_x	M/C	Cement kiln	BCA 2004	3.19 kg/te of clinker produced.
PAHs[38]	M/C	Cement kiln	BCA 2004	2.43×10^{-4} kg/te of clinker produced.
Total particulate matter	M/C	Cement kiln	BCA 2004	0.16 kg/te of clinker produced.
PM_{10}	M/C	Cement kiln	BCA 2004	0.09 kg/te of clinker produced.
SO_x	M/C	Cement kiln	BCA 2004	1.69 kg te of clinker produced.
Metals				
As	M/C	Cement kiln	BCA 2004	2.0×10^{-6} kg/te of clinker produced.
Cd	M/C	Cement kiln	BCA 2004	6.0×10^{-6} kg/te of clinker produced.
Cu	M/C	Cement kiln	BCA 2004	1.9×10^{-5} kg/ te of clinker produced.
Cr	M/C	Cement kiln	BCA 2004	4.8×10^{-5} kg/ te of clinker produced.
Hg	M/C	Cement kiln	BCA 2004	2.2×10^{-5} kg/ te of clinker produced.
Mn	M/C	Cement kiln	BCA 2004	6.0×10^{-5} kg te of clinker produced.
Ni	M/C	Cement kiln	BCA 2004	2.3×10^{-5} kg/te of clinker produced.
Pb	M/C	Cement kiln	BCA 2004	6.95×10^{-4} kg/te of clinker produced.
V	M/C	Cement kiln	BCA 2004	1.1×10^{-5} kg/te of clinker produced.

Reference Table 4 – Lime source factors

---

[34] M=measurement, C=calculation, E=estimation (engineering judgement).
[35] .The threshold for CO_2 applies to the overall CO_2 emission (thermal and chemical combined). The percentage biomass figure; i.e. the percentage of your CO_2 figure attributed to non-fossil fuel combustion sources can be recorded within your return form.
[36] It is anticipated that N_2O emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[37] It is anticipated that CH_4 emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[14] From 2006 the SPRI requires reporting of the annual emissions of listed individual PAH compounds (with individual reporting thresholds) rather than a PAH total.

The table below shows the pollutants likely to be reported from typical cement production processes. For pollutants not contained within this table a return of not applicable, *N/A*, is expected, to indicate that this pollutant is not knowingly discharged by the site.

Emissions to air

Determinand	Method[15]	Emission Source	Reference	Factors and guidance
CO	M	Lime kiln	None	*None*
CO_2[16]	C	Site combustion and process sources	EU ETS	Guidance from EU Commission– as part of EU ETS.[17]
CH_4[17]	C	Lime kiln	None	None
Dioxins and furans	M	Lime kiln	None	None
HCl	M	Lime kiln	None	None
Fluorine and inorganic compounds – as HF	M	Lime kiln	None	None
NMVOCs	M	Lime kiln	None	None
NO_x	M	Lime kiln	None	None
PAHs[18]	M	Lime kiln	None	None
Total particulate matter	M	Lime kiln	None	None
PM_{10}	M	Lime kiln	None	None
SO_x	M	Lime kiln	None	None
Metals				
As	M	Lime kiln	None	None
Cd	M	Lime kiln	None	None
Cu	M	Lime kiln	None	None
Cr	M	Lime kiln	None	None
Hg	M	Lime kiln	None	None
Mn	M	Lime kiln	None	None
Pb	M	Lime kiln	None	None

[15] M=measurement, C=calculation, E=estimation (engineering judgement).
[16] The threshold for CO_2 applies to the overall CO_2 emission (thermal and chemical combined). The percentage biomass figure, i.e. the percentage of your CO_2 figure attributed to non-fossil fuel combustion sources, can be recorded within your return form.
[17] It is anticipated that N_2O emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[18] It is anticipated that CH_4 emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.

6 Production and processing of metals sector guidance

This Note covers activities that are regulated as "Production and processing of metals" under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended; PPC Regulations). Included within the scope are Part A prescribed/listed activities regulated under Chapter 2, Sections 2.1 (Ferrous metals) and 2.2 (Non-ferrous metals) of the PPC regulations. SPRI guidance for combustion activities is covered in the appropriate Section of this Guidance Note.

6.1 Air Emissions

6.1.1 Relevant pollutants

The main air emissions from ferrous and non-ferrous metals production and processing activities are shown in Tables 15 and 16 respectively. The tables should be taken as a guide only, and you should verify that there are no other pollutants emitted from your process.

Table 15 – Main air pollutants emitted by ferrous metal and related activities and their main sources

Main air pollutants	Release point
CO_2	Sinter plant, hot blast stoves, blast furnaces, basic oxygen steelmaking (BOS) blowing & charging operations, arc furnace melting and refining, arc furnace and ladle treatment scarfing, coke ovens re-heating.
CO	Sinter plant, hot blast stoves, blast furnaces, BOS blowing and charging operations, arc furnace melting and refining, scarfing, emergency venting, re-heat furnaces.
NO_X	Sinter plant, hot blast stoves, arc furnace charging, melting and refining, nitric acid pickling, coke oven under-firing, emergency flaring, ammonia incinerator tail gas.
Particulate matter (including PM_{10})	Raw material handling, sinter plant, coal pulverisation, stockpiles, blast furnaces, desulphurisation plant, BOS/electric arc primary and secondary extraction charging and tapping operations, ingot casting, scarfing, skull burning, coke oven door leakage/underfiring/charging/pushing, emergency venting, emergency flaring, quenching ammonia incinerator tail gas.
SO_2	Sinter plant, hot blast stoves, arc furnace charging, melting and refining, slag processing, coke oven underfiring, ammonia incinerator tail gas, blast furnace casthouse extraction, re-heating.
VOCs	Sinter plant, coke oven charging emissions, door leakage and by-products plant, decanters and storage tank vents.
NH_3	Coke oven charging emissions/door leakage.
HCl	Sinter plant, hydrochloric acid pickling.
HCN	Coke oven charging/door and top leakage.
Fluorine and inorganic compounds – as HF	Sinter plant, arc furnace melting and refining, ladle treatments, electro slag re-melting.
H_2S	Slag processing, coke oven door leakage, emergency venting, decanter and storage tank vents.
Metals	Sinter plant, BOS charging & tapping operations, arc furnace charging, melting and refining.
Dioxins & furans	Sinter plant, arc furnace steel making.
CH_4	Sinter plant, coke oven door leakage.
PCBs	Sinter plant, electric arc furnace steel making.
BTX	Coke oven door leakage, emergency venting, decanters and storage tank vents.

Main air pollutants	Release point
PAHs*	Sinter plant, electric arc furnace steel making, coke oven door and top leakage.
Phenols	Coke oven door and top leakage, emergency venting, decanters and storage tank vents, coke oven by-product plant.
* Reference to PAHs is for collective convenience. See the SPRI Schedule for which individual PAHs you should report.	

Table 16 – Main air pollutants emitted by non-ferrous metal and related activities and their main sources

Main air pollutants	Release point
CO_2	Melting furnaces.
CO	Shaft furnaces in copper processes, nickel and cobalt processes.
NO_x	Pre-treatment; copper, aluminium, lead, zinc, cadmium, precious metal, refractory metal, ferro-alloy, alkali and alkaline metal, nickel and cobalt processes; carbon and graphite production.
Total particulate matter (including PM_{10} as a % of total)	Raw material storage and handling; pre-treatment; copper, aluminium, lead, zinc, cadmium, precious metal, refractory metal, ferro-alloy, alkali and alkaline metal, nickel and cobalt processes; carbon and graphite production; residue handling storage and re-use; air abatement plant.
SO_2	Pre-treatment; copper, aluminium, lead, zinc, cadmium, precious metal, refractory metal, ferro-alloy, alkali and alkaline metal, nickel and cobalt processes; carbon and graphite production.
VOCs	Pre-treatment; copper, aluminium, lead, zinc, cadmium, precious metal, refractory metal, ferro-alloy, alkali and alkaline metal, nickel and cobalt processes; carbon and graphite production; air abatement plant.
NH_3	Aluminium, precious metal, refractory metal processes.
HCl	Aluminium and precious metal processes, pickling.
Fluorine and inorganic compounds – as HF	Aluminium and precious metal processes, pickling.
Chlorine and inorganic compounds – as HCl	Aluminium, lead, zinc, cadmium, precious metal, refractory metal, alkali and alkaline metal processes.
Dioxins and furans	Pre-treatment; copper, aluminium, lead, zinc, cadmium, precious metal, refractory metal, ferro-alloy, alkali and alkaline metal, nickel and cobalt processes; carbon and graphite production; residue handling storage and re-use; air abatement plant.
Sulphides and mercaptans	Precious metal processes.
PAHs*	Aluminium processes, carbon and graphite production.
PFCs	Aluminium processes.
Non-ferrous metals	Raw material storage and handling; pre-treatment; copper, aluminium, lead, zinc, cadmium, precious metal, refractory metal, ferro-alloy, alkali and alkaline metal, nickel and cobalt processes; carbon and graphite production; residue handling storage and re-use; air abatement plant.
* Reference to PAHs is for collective convenience. See the SPRI Schedule for which individual PAHs you should report.	

6.2.1 Point source emissions

These emissions are exhausted via a stack or vent; i.e. a single point source into the atmosphere. Abatement equipment; e.g. scrubbing units, fabric filters (bag house) can be incorporated into the exhaust system prior to discharge to atmosphere. Point source emissions will be the most significant emission source for combustion activities taking place within metals processing and production sites. Other non-combustion point source emissions (sintering, coke-making, smelting, refining, alloying, etc.) arise from a IEDe range of ferrous and non-ferrous processes and activities.

6.2.2 Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack. Only fugitive emissions that leave the site need to be reported to the SPRI. Whilst contained spills would therefore not need to be reported, you should report vapour emissions that may have dispersed.

Ferrous metals

Fugitive emissions from coke and iron and steel processes can be as significant as point source emissions. Some examples of the potential sources of fugitive emissions to air are:

- Leakage of volatile materials through ascension pipe, door and lid seals on coke ovens;
- Open vessels (e.g. coke oven by-product plant);
- Cast house fume abatement systems overloaded; BOS primary and secondary fume collection;
- Coal and ore stockpiles;
- Vehicle loading and unloading areas;
- Transferring material between vessels (e.g. furnace, ladle, silos); Conveyor systems;
- Pipe work and ductwork systems (e.g. pumps, valves, flanges);
- Abatement equipment by-pass (e.g. coke side particulate collection hoods);
- Accidental loss of containment from failed plant and equipment;
- Solvents; and
- Miscellaneous un-extracted combustion activities.

Non-ferrous metals

At most sites where non-ferrous metals processes are carried out, fugitive emissions to air give rise to a significant proportion of the overall environmental impact. Some examples of the sources of fugitive emissions to air are:

- Smelting, melting and refining furnaces and their associated extraction systems;
- Transfer operations involving molten metal;
- Casting and associated activities;
- Handling and storage of dusty raw materials such as concentrates, foundry sand, drosses;
- Handling, storage and disposal of wastes such as drosses, slags and skimmings;
- Fume treatment plant;
- Ladle heating stations; and
- Vehicle loading and unloading areas.

6.3   Emissions to water and wastewater

6.3.1   Relevant pollutants and emissions sources

Water discharges from ferrous and non-ferrous metals processes can be contaminated by a variety of polluting substances. Tables 17 and 18 illustrate the main substances emitted to water and their main sources. The tables should be taken as a guide only, and you should verify that there are no other pollutants emitted from the process. Suspended solids, and oils and greases are not SPRI-reportable substances; however, you may need to take account of other substances that are being emitted in association with such materials.

Table 17 – Main water pollutants generated by ferrous metal and related activities

Main water pollutants	Release point
Oils and greases	Steel scrap storage and handling, residue handling, storage and re-use, continuous casting, rolling mills.
NH_3	Blast furnace primary gas cleaning, effluent plant, coke oven by-products.
Cyanides – as CN	Blast furnace primary gas cleaning, effluent plant, coke oven by-products.
PAHs	Coke oven by-products.
Suspended solids	Raw material storage and handling, residue handling, storage and re-use, effluent plant, blast furnace and BOS gas cleaning, rolling mills.
Metals	Effluent treatment discharge
TOC	Steel scrap storage and handling, residue handling, storage and re-use, continuous casting, rolling mills, by-products plant.

Table 18 – Main water pollutants generated by non-ferrous metal and related activities

Main water pollutants	Release point
Oils and greases	Raw material storage and handling, residue handling, storage and re-use, effluent plant.
NH_3	Aluminium, precious metal, refractory metal processes, effluent plant.
Cyanides – as CN	Aluminium, precious metal processes, effluent plant.
PAHs	Aluminium processes, carbon and graphite production.
Suspended solids	Raw material storage and handling, residue handling, storage and re-use, effluent plant.
PFCs	Aluminium processes.
Cd	Raw material storage and handling, effluent plant.
Hg	Raw material storage and handling, effluent plant.
Other metals	Effluent treatment discharge.

The resulting discharge of the above substances depends on the 'in process' preventative measures (good housekeeping, re-use) and the presence and technical standards of wastewater treatment facilities.

6.4   Off-site waste transfers

6.4.1   Relevant wastes

Integrated steelworks
The management of residues in an integrated steelworks is characterised by advanced techniques for extracting value from recycling most of the residues in the sinter plant, BOS plant and coke ovens. The iron and steel sector is an important recycler of materials. All the ferrous scrap arisings in the UK is recycled, the bulk of it by the UK steel industry. Only small parts of the overall quantity of wastes are landfilled, including the following:

- Fine dust from blast furnace gas cleaning;
- Rubble;
- Fine dust from basic oxygen furnace gas scrubbing (where wet cleaning is used);
- Alkali metal chlorides and heavy metal chlorides from electrostatic precipitators;
- Refractory waste; and
- General wastes (e.g. packaging).

Hot and cold rolling mills
Hot rolling operations generate the following waste products which are sent off-site:

- Metal-bearing wastes (e.g. oily mill scale);
- Dusts from scarfing and rolling;
- Oily and non-oily mill scale;
- Water treatment and mill scale sludge; and
- Oil and greases (can be used as secondary fuel in blast furnace or coke ovens).

Cold rolling operations generate the following waste products which are sent off-site:

- Acid neutralisation sludges; and
- Oily sludges.

Non-ferrous metal activities
The production of non-ferrous metals from primary and secondary raw materials gives rise to the generation of a IEDe variety of by-products, intermediate products and residues some of which are given below:

- Skimmings;
- Tars/carbon-containing wastes from anode manufacture;
- Flue gas dust;
- Gas treatment sludges;
- Lining and refractory waste;
- Wastewater treatment sludge;
- Waste oils; and
- Absorbents and filter materials.

Transboundary shipments of hazardous waste
For transboundary movements of hazardous waste (outwith the United Kingdom), the name and address of the recoverer or the disposer of the waste and the actual recovery or disposal site have to be reported.

Reference Table 5 – Ferrous metals source factors

This Reference Table is designed to be an aid for compiling SPRI submissions from ferrous metal processes, and covers the major categories of emission sources; process emissions (integrated iron and steel processes, coke-making and rolling mills), combustion emissions (heaters, boilers, etc.), fugitive emissions, wastewater, etc. It also includes emission factors where available.

The table below addresses all the pollutants which we consider potentially emitted from typical ferrous metal processes. For pollutants not contained within this table a return of not applicable, N/A, is in most cases to be expected, to indicate that this pollutant is not knowingly discharged by the site. Where a site is reporting for the first year non-relevant pollutants will have to be deleted within the electronic form.

Emissions to air

Determinand	Method[7]	Emission Source	Reference	Factors and Guidance
Benzene	C	Coke-making		
Cd	M/C	Coke-making		
	M	Sinter plant		
	M/C	Blast furnace		
	M	Steel making		
	C	1º and 2º rolling mills		
	M/C	Combustion		
CO	M/C	Combustion		
	M/C	Coke oven charging and door leakage		
	M/C	Coke oven pushing		
	M/C	Sinter plant wind box		
	C	BOS refining		
	C	EAF steel making		
	C	1º and 2º rolling mills		
CO_2	C	Combustion and process sources	EU ETS	Guidance from EC – as part of EU ETS.
CH_4[8]	C	Combustion		
	C	Coke-making		
Dioxins and Furans	M	Sinter plant		
	M	EAF steel making		
HCl	M/C	Combustion		
	M/C	Sinter plant		
	M/C	Acid pickling		
HCN	M/C	Coke making		
F and inorganic compounds – as HF	M/C	Sinter plant		
	M/C	EAF steel making		
H_2S[9]	M/C	Coke making		

---

[7] In method column M=measurement, C=calculation, E=estimation (engineering judgement).
[8] It is anticipated that methane emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.

Determinand	Method'	Emission Source	Reference	Factors and Guidance
NH$_3$	M/C	Coke oven charging		
	M/C	Coke oven door leakage		
	M/C	Coke oven pushing		
	C	1° and 2° rolling mills		
NMVOCs	M/C	Coke oven charging		
	M/C	Coke oven door leakage		
	M/C	Coke oven pushing		
	M/C	Sinter plant		
NO$_x$	C	Combustion	EA	Site specific factors agreed for combustion plant.
	M/C	Coke oven charging		
	M/C	Coke oven door leakage		
	C	EAF steel making		
	M/C	Sinter plant		
	M/C	Blast furnace		
	C	1° and 2° rolling mills		
N$_2$O[10]	C	Combustion		
PAHs[11]	C	Combustion		
	M/C	Coke-making		
	M/C	Sinter plant		
	M/C	Blast furnace		
PCBs as WHO-TEQ	M	EA steel making		
	M	Sinter plant		
Phenol	M/C	Coke-making		
	M/C	Sinter plant		
Total particulate matter	C	Combustion		

---

[9] Not stated on SPRI list of pollutants, but reportable as "Other individual acid-forming gases".
[10] It is anticipated that N$_2$O emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[11] From 2006 the SPRI required reporting of the annual emissions of listed individual PAH compounds (with individual reporting thresholds) rather than a PAH total.

Determinand	Method[1]	Emission Source	Reference	Factors and Guidance
PM$_{10}$ (also PM$_{2.5}$)	C	Combustion		
	M/C	Coke oven charging		
	M/C	Coke oven door leakage		
	M/C	Coke oven pushing		
	M/C	Coke oven flue gas		
	M/C	Sinter plant wind box		
	M/C	Sinter plant waste gas discharge		
	C	Blast furnace slips		
	C	Blast furnace cast house, furnace and tap hole/through		
	C	Hot metal desulphurisation		
	C	BOS refining		
	C	BOS charging		
	C	BOS tapping		
	C	BOS hot metal transfer		
	C	EAF steel making		
	C	Steel teeming		
	C	Steel casting		
	C	1° and 2° rolling mills		
SO$_X$	C	Combustion	Industry experience	Fuel sulphur content x flow rate.
	C	Sinter plant		
	M/C	Coke oven charging		
	M/C	Coke oven flue gas		
	C	Blast furnace		
Toluene	M/C	Coke-making		
	M/C	Sinter plant		
	M/C	Blast furnace		
Xylene	M/C	Coke making		
	M/C	Sinter plant		
	M/C	Blast furnace		
Zn	M/C	Sinter plant		

Determinand	Method'	Emission Source	Reference	Factors and Guidance
Other Metals				
As	M			
Cr	M			
Cu	M			
Mn	M			
Ni	M			
Pb	M			
Sb	M			

Releases to the water environment and transfers in wastewater

Wherever possible data should be net of incoming cooling water quality, however where this would result in a negative return (i.e. removal of pollutants from incoming waters) a N/A return should be made unless alternative local arrangements have been made with us. This can be applied where the substance has been reported previously. Where a site is reporting for the first year non relevant pollutants will have to be deleted within the electronic form.

Determinand	Method	Emissions Source	Reference	Factors and Guidance
As	M	Effluent Treatment Facilities		Effluent quality data
Cd	M	Effluent Treatment Facilities		Effluent quality data
Chlorides (as total Cl)	M	Effluent Treatment Facilities		Effluent quality data
Cr	M	Effluent Treatment Facilities		Effluent quality data
Cu	M	Effluent Treatment Facilities		Effluent quality data
Cyanides (as total CN)	M	Effluent Treatment Facilities		Effluent quality data
Fluorides (as total F)	M	Effluent Treatment Facilities		Effluent quality data
Hg	M	Effluent Treatment Facilities		Effluent quality data
NH_3	M	Effluent Treatment Facilities		Effluent quality data
Ni	M	Effluent Treatment Facilities		Effluent quality data
Pb	M	Effluent Treatment Facilities		Effluent quality data
PAHs*	M	Effluent Treatment Facilities		Effluent quality data
Phenols (as C)	M	Effluent Treatment Facilities		Effluent quality data
TOC	M	Effluent Treatment Facilities		Effluent quality data
Zn	M	Effluent Treatment Facilities		Effluent quality data

* Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1, 2, 3-cd)pyrene.

Reference Table 6 – Non-ferrous metals source factors

This Annex is designed to be an aid for compiling SPRI submissions from non-ferrous metal processes, and covers the major categories of emission sources; process emissions, combustion emissions (heaters, boilers, etc.), fugitive emissions, wastewater, etc.

The table below addresses all the pollutants which we consider potentially emitted from typical non-ferrous metal processes. For pollutants not contained within this table a return of not applicable, N/A, is in most cases to be expected, to indicate that this pollutant is not knowingly discharged by the site.

Emissions to air

Determinand	Method[12]	Emission Source	Reference	Factors and guidance
Benzene				
Cd	M			
Cl and inorganic compounds as Cl				
CO	M	Combustion		
CO_2	C	Site combustion and process	EU ETS	Guidance from EC part of EU ETS.
CH_4[13]	C	Combustion		
Dioxins and Furans	M	Process		
HCl	M			
F and inorganic compounds as HF	C	Primary aluminium alumina reduction		
HFCs				
Hg	M			
NH_3	M			
NMVOCs	M			
NO_x	C	Combustion	EA	Site specific factors agreed for combustion plant.
N_2O[17]	C	Combustion		
PAHs[15]	C	Combustion		
	C	Primary aluminium alumina reduction		
PFCs				
Total particulate matter	C	Combustion		
	C	Primary aluminium anode production		
	C	Primary aluminium alumina reduction pre-bake cell		
	C	Secondary aluminium sweating furnace		
	C	Secondary aluminium smelting (crucible furnace)		
	C	Secondary aluminium smelting (reverberatory furnace)		
	C	Secondary aluminium chlorine demagging		
	C	Secondary aluminium refining		

Determinand	Method[12]	Emission Source	Reference	Factors and guidance
PM$_{10}$	C	Combustion		
	C	Secondary magnesium pot furnace		
	C	Primary zinc roasting		
	C	Primary zinc sinter plant		
	C	Primary zinc vertical retort		
	C	Primary zinc electric retort		
	C	Primary zinc electrolytic process		
	C	Secondary zinc reverberatory sweating		
	C	Secondary zinc kettle pot		
	C	Secondary zinc calcining		
PM$_{10}$	C	Secondary zinc electric resistance sweating		
	C	Secondary zinc muffle sweating		
	C	Secondary zinc kettle sweating		
	C	Secondary zinc rotary sweating		
	C	Secondary zinc retort and muffle distillation		
	C	Secondary zinc retort distillation/oxidation		
	C	Secondary zinc muffle distillation/oxidation		
	C	Secondary zinc retort reduction		
PM$_{10}$	C	Secondary zinc fugitive emissions		
	C	Primary lead ore crushing		
	C	Primary lead ore screening		
	C	Primary lead tetrahedrite dryer		
	C	Primary lead sinter machine		
	C	Primary lead sinter building fugitives		
	C	Primary lead blast furnace		
	C	Secondary lead fugitive emissions		
	C	Secondary lead sweating		
	C	Secondary lead reverberatory smelting		
	C	Secondary lead blast smelting cupola		
	C	Secondary lead kettle oxidation		
	C	Secondary lead casting		
	C	Secondary lead kettle refining		
	C	Primary copper reverberatory furnace followed by converter		

Determinand	Method[12]	Emission Source	Referenc	Factors and guidance
	C	Primary lead ore crushing		
	C	Primary lead ore screening		
	C	Primary lead tetrahedrite dryer		
	C	Primary lead sinter machine		
	C	Primary lead sinter building fugitives		
	C	Primary lead blast furnace		
	C	Secondary lead fugitive emissions		
	C	Secondary lead sweating		
	C	Secondary lead reverberatory smelting		
	C	Secondary lead blast smelting cupola		
	C	Secondary lead kettle oxidation		
	C	Secondary lead casting		
	C	Secondary lead kettle refining		
	C	Primary copper reverberatory furnace followed by converter		
PM_{10}	C	Primary copper multiple hearth roaster followed reverberatory furnace and converter		
	C	Primary copper fluid bed roaster followed by reverberatory furnace and converter		
	C	Primary copper concentrate dryer followed by electric furnace and converter		
	C	Primary copper fluid bed roaster followed by electric furnace and converter		
	C	Primary copper concentrate dryer followed by flash furnace, cleaning furnace and converter		
	C	Primary copper concentrate dryer followed by Noranda reactors and converter		
	C	Primary copper fugitive emissions		
	C	Secondary copper cupola		
	C	Secondary copper reverberatory furnace		
PM_{10}	C	Secondary copper crucible and pot furnace		
	C	Secondary copper electric arc furnace		
	C	Secondary copper electric induction		
	C	Secondary copper rotary furnace		
Phenol	C	Primary aluminium alumina reduction		

Determinand	Method[12]	Emission Source	Reference	Factors and guidance
SO$_X$	C	Combustion	Industry Experience	Fuel sulphur content x flow rate
	C	Flare	Industry Experience	Flared-gas sulphur content x flow rate
	C	Primary copper reverberatory furnace followed by Converter		
	C	Primary copper multiple hearth roaster followed reverberatory furnace and converter		
	C	Primary copper fluid bed roaster followed by reverberatory furnace and converter		
	C	Primary copper concentrate dryer followed by electric furnace and converter		
	C	Primary copper fluid bed roaster followed by electric furnace and converter		
	C	Primary copper concentrate dryer followed by flash furnace, cleaning furnace and converter		
	C	Primary copper concentrate dryer followed by Noranda reactors and converter		
	C	Primary copper fugitive emissions		
	C	Primary lead sinter machine		
	C	Primary lead blast furnace		
	C	Secondary lead blast smelting cupola		
	C	Secondary lead reverberatory smelting		
Toluene				
Trichloroethylene				
Xylene				
Zn	M			

Other Metals				
As	M			
Cu	M			
Cr	M			
Mn	M			

[12] In method column M=measurement, C=calculation, E=estimation (engineering judgement).
[13] It is anticipated that CH_4 emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[14] It is anticipated that N_2O emissions will be included in future phases of the EU ETS – estimation methodologies may therefore require adaptation when EU monitoring and reporting decisions are published.
[15] From 2006 the SPRI required reporting of the annual emissions of listed individual PAH compounds (with individual reporting thresholds) rather than a PAH total.

Determinand	Method[12]	Emission Source	Reference	Factors and guidance
Ni	M			
Pb	M/C	Secondary copper reverberatory furnace		
	C	Primary lead ore crushing		
	C	Primary lead ore screening		
	C	Primary lead tetrahedrite dryer		
	C	Primary lead sinter machine		
	C	Primary lead sinter building fugitives		
	C	Primary lead blast furnace		
	C	Secondary lead sweating		
	C	Secondary lead reverberatory smelting		
	C	Secondary lead blast smelting cupola		
	C	Secondary lead kettle refining		
	C	Secondary lead casting		
	C	Secondary lead smelting		
	C	Secondary lead kettle refining		
	C	Secondary lead casting		
	C	Secondary lead sweating		
Sb	M			

Releases to the water environment and transfers in wastewater

Wherever possible data should be net of incoming cooling water quality, however where this would result in a negative return (i.e. removal of pollutants from incoming waters) a N/A return should be made unless alternative local arrangements have been made with us.

Determinand	Method	Emissions Source	Reference	Factors and Guidance
Cd	M	Effluent Treatment Facilities		Effluent quality data
Chlorides (as total Cl)	M	Effluent Treatment Facilities		Effluent quality data
Cyanides (as total CN)	M	Effluent Treatment Facilities		Effluent quality data
Fluorides (as total F)	M	Effluent Treatment Facilities		Effluent quality data
Hg	M	Effluent Treatment Facilities		Effluent quality data
NH_3	M	Effluent Treatment Facilities		Effluent quality data
PAHs*	M	Effluent Treatment Facilities		Effluent quality data
TOC	M	Effluent Treatment Facilities		Effluent quality data
Zn	M	Effluent Treatment Facilities		Effluent quality data

* Benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1, 2, 3-cd)pyrene.

7 Combustion sector guidance

This Section covers activities that are regulated as "Combustion activities" under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended; PPC Regulations). Included within the scope are Part A prescribed/listed activities regulated under Chapter 1, Section 1.1 of the PPC Regulations.

7.1 Air pollutants

The main air emissions from the combustion of fossil fuels will almost always lead to releases to air of CO_2, CO, NO_x and particulate matter. Other pollutants will be released dependent on the fuel and combustion technology used, particularly SO_2. Smaller quantities of pollutants such as trace metals, hydrogen halides, un-burnt hydrocarbons, non-methane volatile organic compounds (NMVOCs) and dioxins may also be emitted, but they may have a significant influence on the environment due to their toxicity or their persistence.

Pyrolysis and gasification can be used to pre-treat fuels in order to remove impurities or to produce fuel that can be combusted more readily. The fuels can be either pre-cleaned before combustion or directly combusted. The pollutants emitted from the process are therefore critically dependent on the fuel used and the nature of the process.

The following table illustrates the likely pollutants emitted from different types of fuel. The table should be taken as a guide only, and you should verify that there are no other pollutants emitted from your process.

Table 19 – Guide of main pollutants emitted by combustion activities to air

Fuel type	Inputs	Potential air emissions
Solid	Coal	NO_x, CO, CO_2, SO_x, particulate matter (including PM_{10} and $_{2.5}$), fugitive dust, trace metals, PCBs and PAHs, hydrogen halides, methane, NMVOCs, dioxins, N_2O.
	Biomass+	NO_x, CO, CO_2, SO_x (low), particulate matter (including PM_{10} and $_{2.5}$), CH_4, NMVOCs, trace metals (from sewage sludge).
Liquid	Fuel oil	NO_x, CO, CO_2, SO_x, particulate matter (including PM_{10} and $_{2.5}$), PCBs and PAHs, hydrogen chloride, trace metals, and dioxins.
Gaseous	Natural gas	NO_x, CO, CO_2, CH_4.
Secondary fuels	Solid, liquid or gaseous	NO_x, CO, CO_2, SO_x, particulate matter (including PM_{10} and $_{2.5}$), PCBs and PAHs, hydrogen halides, trace metals, NMVOCs, H_2S, ammonia and dioxins.
* The percentage proportion of the total CO_2 attributable to biomass (non-fossil fuel) can be recorded within Section C of the SPRI reporting form, within the carbon dioxide substance. This is the percentage of the total CO_2 emissions attributable to biomass fuels. Where you record "BRT" you can still enter a percentage figure within the "Biomass Percentage" box □. If you calculate you are above the reporting threshold enter the total CO_2 figure which should include both fossil fuel emissions as well as biomass-derived emissions.		

Subsidiary or substitute fuels may contain other pollutants that will require reporting.

7.1.1 Point source emissions

These emissions are exhausted via a stack or vent; i.e. a single point source into the atmosphere. Abatement equipment; e.g. an electrostatic precipitator (ESP) or fabric filter (bag house) can be incorporated into the exhaust system prior to discharge to atmosphere. Point source emissions will be the most significant emission source for combustion activities.

7.1.2 Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack. Examples of fugitive emissions include dust from coal and ash stockpiles and entrainment of pollutants during material handling. Leaks from valves and flanges are also examples of fugitive emissions. With appropriate management and control, these emission sources are generally minor for the combustion sector. Only fugitive emissions that leave the site need to be reported to the SPRI. Whilst contained spills would therefore not need to be reported, you should report vapour emissions that may have dispersed.

7.1.3 Quantification of emissions

You should refer to the SEPA SPRI Release Estimation Techniques (RET) Guidance Note 2017 for information on quantification of emissions.

Using continuous emission monitoring systems (CEMS)

For the Electricity Supply Industry (ESI), it may not be possible to obtain valid CEMS data during start-up and shut-down. In these circumstances, for the purposes of reporting to the SPRI, an alternative approach, for example using emission factors, can be used by agreement.

7.1.4 General emission factors

You should refer to the SEPA SPRI Release Estimation Techniques (RET) Guidance Note.

7.1.5 Carbon dioxide emission factors

The EC has established guidelines for the monitoring and reporting of GHGs pursuant to European Directive 2003/87/EC establishing the EU ETS. The European guidance sets out the approved methodology for estimating CO_2 emissions based on emissions from regular operations and abnormal events, including start-up and shut-down and emergency situations over the reporting period.

Under the EU ETS guidelines, the EC has put monitoring and reporting into a European-level Regulation, to bring harmonisation across Europe. The Monitoring and Reporting Regulation (MRR) is defined within EC Regulation 601/2012. Further information on CO_2 reporting can be found on the EC's website.

Under the EU ETS guidelines, estimation of CO_2 emissions from combustion sources is based on the following formula.

Equation 4

$$E_{CO_2} = A_e \times EF_{CO_2} \times OF_{CO_2}$$

Where:	E_{CO_2}	Emission rate of CO_2 (te/yr)
	A_e	Activity rate (annual energy consumption) (TJ/yr)
	EF_{CO_2}	Emission factor of CO_2 (teCO_2/TJ)
	OF_{CO_2}	Oxidation factor

The oxidation factor takes into account the fact that when energy is consumed not all of the carbon in the fuel oxidises to CO_2. The oxidation factor expresses the proportion of carbon in the fuel that is oxidised to CO_2.

The EU ETS provides specific guidance regarding the determination of activity-specific emission factors for defined fuels. In the absence of activity-specific factors, general emission factors for the combustion of various fossil fuels are provided in the EU ETS guidance.

By contrast to combustion sources of CO_2 emissions, the EU ETS allows process emissions (emissions of CO_2 from non-combustion activities) to be derived from activity data based on raw material inputs, throughputs and outputs. The basic calculation equation remains multiplication of activity data by appropriate emission factors, but use of conversion factors (CFs) in place of oxidation factors.

Biomass is considered to be CO_2 neutral in terms of the EU ETS, but the mass of CO_2 emitted from its combustion or use is an SPRI reporting requirement and should at least match or be greater than your reported ETS figures. The proportion of the total CO_2 attributable to biomass should be recorded within the Method Description or Qualification box □ and the Biomass Percentage recorded within the SPRI reporting form.

Under the EU ETS Guidelines, operators can choose the most appropriate oxidation factor tier, shown below:

Table 20 – CO_2 oxidation factor tiers

Tier 1	An oxidation of 1 is used.
Tier 2	The operator applies oxidation factors for the respective fuel as reported in the UK Greenhouse Gas Inventory (UKGHGI) (country-specific factors).
Tier 3	For fuels activity-specific factors are derived by the operator using approved methodologies

In some cases the emission factor may already take into account the proportion of carbon in the fuel that is oxidised and you should verify if this is the case. If so, the oxidation factor in Equation 4 is equal to 1.

It is also possible to use an emission factor based on the amount of fuel used, in essence Equation 4 from the RET Guidance. This is due to the fact that the annual energy consumption is related to annual fuel consumption by the net thermal capacity of the fuel.

The EU ETS allows CO_2 emissions to be determined by two methodologies; a calculation methodology or a measurement methodology. However, where a measurement methodology is used, a requirement exists to verify the measured emissions by calculation. In both cases however, it is likely that measurements of fuel burned or fuel flow will be available and these can be used for the determination of other emission quantities when combined with appropriate emission factors.

7.1.6 Solid fuel combustion factors

(a) Electricity supply industry (ESI)

The emission factors contained in this Section (and in 7.1.7(a) and 7.1.8(a)) represent currently agreed factors for electricity generating stations. They have been developed from measurements on large electricity generating stations (greater than 300 MW$_{th}$) and are regularly updated. Further detail on these emission factors is contained in the ESI methodology.

Also included in Table 21 are estimates of the amount of 'as received' coal that would need to be burnt in a year in order to exceed the reporting thresholds. However, a value for the tonnes of coal that would need to be burnt for SO_3 has not been provided, as it will be reported with SO_2 (which is either normally estimated from CEMS or fuel analyses in accordance with Section 2 of the RET Guidance). ESI plant burning less than the indicated tonnage of coal should therefore report emissions as 'BRT' for that particular pollutant, provided that there are no other sources of the pollutant on site.

Emissions of NO$_x$ from ESI coal-fired power plants that do not use CEMS for annual mass emissions can be calculated from the fuel burn and NO$_x$ factors which have been agreed with SPRI on a station-specific basis.

PM concentrations are normally measured by CEMS for ESI plant. The annual mass emission should be calculated from the instantaneous measured concentration multiplied by the instantaneous volumetric emission, as in Equation 1 of the RET Guidance. Where load and abatement performance is constant, the average concentration and flow rate can be used (Equation 2 of the RET Guidance). For ESI plant it is generally assumed that each tonne of coal generates 9,000 m^3 of flue gas normalised at 6% oxygen concentration.

The SPRI return requires the Total, PM_{10} and $PM_{2.5}$ fractions of the particulate matter to be reported. For ESI coal-fired plant, the PM_{10} and $PM_{2.5}$ fractions are assumed to be 80% and 40% respectively of the total particulate matter emitted where ESP is used. For plant with FGD the PM_{10} and $PM_{2.5}$ fractions are assumed to be 90% and 80% respectively of the total particulate matter emitted. You can also use these factors when burning peat or biomass.

Emissions of hydrogen chloride, "chlorine and inorganic compounds – as HCl" and "fluorine and inorganic compounds – as HF" are normally estimated from fuel analysis, as shown in Section 2 of the RET Guidance.

Table 20 – 2013 UK ESI PI emission factors for large combustion plant

Pollutant species	Emission factor (kg/tonne 'as received' coal burnt) for pulverised coal plant with or without FGD	[te coal burnt for above reporting threshold]
Dioxins and furans (expressed as I- TEQ)	1.5×10^{-11}	[666,667]
Dioxins and furans (expressed as WHO–TEQ)	1.6×10^{-11}	[625,000]
PCB (expressed as WHO–TEQ)	1.8×10^{-10}	[55,556]
PCB (expressed as total mass)	9.9×10^{-8}	[1,010,101]
Benzo(a)pyrene (BaP)	9.0×10^{-7}	[1,111,111]
Anthracene*	2.7×10^{-7}	[BRT]*
Benzo(b)fluoranthene	5.4×10^{-7}	[1,851,852]
Benzo(g,h,i)perylene	5.4×10^{-7}	[1,851,852]
Benzo(k)fluoranthene	5.4×10^{-7}	[1,851,852]
Chrysene*	3.6×10^{-7}	[BRT]*
Fluoranthene	4.5×10^{-7}	[2,222,222]
Indeno(1,2,3-cd)pyrene	5.4×10^{-7}	[1,851,852]
Naphthalene	4.9×10^{-5}	[2,040,816]
Methane	1.4×10^{-2}	[714,286]
NMVOCs	2.7×10^{-2}	[370,370]
Carbon monoxide	1.1	[90,909]
SO_3 (reported as part of sulphur oxides – SO_2 and SO_3 as SO_2)	6.3×10^{-2}	-
Nitrous oxide	2.6×10^{-2}	[384,615]
*These emissions should always be reported as below the reporting threshold given the required fuel burn.		

(b) Generic factors

In the absence of other information, generic emission factors based on currently achievable emission rates from various combustion plants can be used. For this Section, 7.1.7(b) and 7.1.8(b) the generic emission factors have been taken from existing UK regulatory guidance for combustion appliances and supplemented with Local Authority Guidance (listed in the useful references Section).

The existing UK regulatory guidance contains achievable emission data post abatement in terms of mg/MJ of net thermal input together with the equivalent normalised emission concentrations (mg/m^3).

If you know the normalised emission concentration of your combustion appliance, you can calculate the equivalent emission factor in terms of mg/MJ and use Equation 5 below. The relevant mg/MJ and mg/m³ values from the guidance are listed in Table 21, Table 23 and Table 25 for each fuel category. The generic emission factors (EFi) for coal-firing are presented in Table 21 below and are expressed in terms of the **net** heat input into the combustion appliance.

Equation 5

$$E = Ae \times EF \times 10^{-6}$$

Where:	E	Emission of pollutant (kg/yr)
	Ae	Annual energy consumption (MJ/yr)
	EF	Energy emission factor of pollutant (teCO$_2$/TJ)

The emission factors also enable an estimate to be made of the size of combustion plant that would need to be operated for the emission to be above the reporting threshold values. These estimates are also included in Table 21 in terms of the average MWth net thermal input of the plant, assuming that the combustion appliance operates for 100% of the year. If the combustion plant operates for less than 100% of the year, the calculated MWth threshold can simply be divided by the percentage operating time to provide the appropriate MWth threshold. For single combustion appliances that are rated less than the indicated MWth threshold, you can make a BRT return. If you have more than one combustion appliance on site, your aggregate emission may be above the threshold value.

Table 21 – Solid fuel-firing generic emission factors (net basis)

Technology	Emission factor	Particulate matter		NOx		CO	
		mg/MJ	mg/m³	mg/MJ	mg/m³	mg/MJ	mg/m³
Stoker boiler, in-furnace desulphurisation*	EF	9	25	105	300	50	150
	Threshold BRT (W$_{th}$)	35		30		63	
CFBC, in-bed desulphurisation*	EF	9	25	70	200	50	150
	Threshold for BRT (MW$_{th}$)	35		45		63	
PFBC, in-bed desulphurisation and SNCR*	EF	9	25	21	60	10	30
	Threshold for BRT (MW$_{th}$)	35		151		315	
PF boiler, dry lime injection, low-NOx burners**	EF	9	25	225	650	35	100
	Threshold for BRT (MW$_{th}$)	35		14		91	
PF boiler, wet limestone scrubbing, low-NOx burners and re-burn***	EF	5	15	87	250	35	100
	Threshold for BRT (MW$_{th}$)	63		36		91	
PF boiler, wet limestone scrubbing, low-NOx burners and SCR***	EF	5	15	70	200	35	100
	Threshold for BRT (MW$_{th}$)	63		45		91	

Technology	Emission factor	Particulate matter		NOx		CO	
		mg/MJ	mg/m³	mg/MJ	mg/m³	mg/MJ	mg/m³
Boiler, 20-50MWth, stoker firing****	EF	108	300	160	450	50	150
	Threshold for BRT (MWth)	2		20		63	
Boiler, 20-50MWth, other firing****	EF	108	300	225	650	50	150
	Threshold for BRT (MWth)	2		14		63	

Note:
*Use HMSO. Process Guidance Note S2 1.01 Combustion processes: large boilers and furnaces 50MW(th) and over, November 1995 ISBN 0-11-753206-1.
**Use HMSO. Process Guidance Note S2 1.03 Combustion processes: gas turbines, September 1995 ISBN 0-11-753166-9.
***Use HMSO. Process Guidance IPC S3 1.01 Combustion processes Supplementary Guidance Note, November 1995 ISBN 0-11-310183.
****Use Local Authority Unit. Assessment for second revision of PG1/3, Process Guidance Note for Part B. Boilers and furnaces with a net rated thermal input of 20 – 50 MWth.

For coal-fired plants incorporating Selective Catalytic Reduction (SCR), an emission factor of 4 mg/MJ (10 mg/m³) for ammonia can be used.

Plant employing Selective Non-catalytic Reduction (SNCR) could also release ammonia and nitrous oxide. In the absence of other information, emission factors for SNCR for ammonia and nitrous oxide releases can be assumed to be 2 mg/MJ (5 mg/m³) and 21 mg/MJ (60 mg/m³) respectively.

For unabated emissions of coal, peat or biomass-powered plant the PM_{10} fraction can be assumed to be 40% of the total particulate matter emitted, rising to 80% for plant with ESPs or bag filters and dry FGD and 95% for plant with ESPs or bag filters and wet FGD.

7.1.7 Emission factors for liquid fuel combustion

(a)   Electricity Supply Industry (ESI)

In a similar manner to Section 7.1.6(a), the UK ESI emission factors are listed in Table 22 for heavy fuel oil-fired (HFO) plant. Further detail on these emission factors is contained in the ESI methodology.

Also included in Table 22 are estimates of the amount of oil that would need to be burnt in order to exceed the reporting thresholds given the listed emission factors. However, a value for the tonnes of oil that would need to be burnt for SO_3 has not been provided, as it will be reported with SO_2. ESI plant burning less than the indicated tonnage of oil should therefore report emissions as BRT for that particular pollutant provided that there are no other sources of the pollutant on site.

Table 22 – 2013 UK ESI PI emission factors for large combustion plant

Pollutant species	Emission factor (kg/tonne oil burnt) for heavy oil-fired plant	[te oil burnt for above the reporting threshold]
Dioxins and furans (expressed as I-TEQ)	2.1×10^{-11}	[497,512]
Dioxins and furans (expressed as WHO–TEQ)	2.1×10^{-11}	[497,512]
PCB (expressed as WHO–TEQ)	2.4×10^{-10}	[41,667]
PCB (expressed as total mass)	1.3×10^{-7}	[769,231]
Benzo(a)pyrene (BaP)	1.2×10^{-6}	[833,333]
Anthracene***	3.6×10^{-7}	[BRT]***
Benzo(b)fluoranthene	7.2×10^{-7}	[1,388,889]
Benzo(g,h,i)perylene	7.2×10^{-7}	[1,388,889]
Benzo(k)fluoranthene	7.2×10^{-7}	[1,388,889]
Chrysene***	4.8×10^{-7}	[BRT]***
Fluoranthene	6.0×10^{-7}	[1,666,667]
Indeno(1,2,3-cd)pyrene	7.2×10^{-7}	[1,388,889]
Naphthalene	6.5×10^{-5}	[1,538,462]
Methane	1.8×10^{-2}	[555,556]
Non-methane volatile organic compounds	3.6×10^{-2}	[277,778]
Carbon monoxide	1.5	[6,667]
SO_3 (reported as part of sulphur oxides - SO_2 and SO_3 as SO_2)	4.2×10^{-2}* 1.08**	[-] [-]
Nitrous oxide	3.5×10^{-2}	[285,714]

Note:
*For plant with Mg (OH) 2 flue gas conditioning.
**For plant without Mg (OH) 2 flue gas conditioning.
***These emissions should always be reported as below the reporting threshold given the required fuel burn.

Emissions of NO_x from ESI oil-fired power plants that do not use CEMS for determining annual mass emission can be calculated from the fuel burn and NO_x factors that have been agreed with SPRI on a station-specific basis.

PM concentrations are normally measured by CEMS for ESI plant. The annual mass emission should be calculated from the instantaneous measured concentration multiplied by the instantaneous volumetric emission, as in Equation 1 of the RET Guidance. Where load is constant, the average concentration and flow rate can be used (Equation 2 in the RET Guidance). For ESI plant it is generally assumed that each tonne of oil generates 12,000m^3 of flue gas normalised at 3% oxygen concentration.

The SPRI return requires the Total, PM$_{10}$ and PM$_{2.5}$ fractions of the particulate matter to be reported. For ESI oil-fired plant, the PM$_{10}$ and PM$_{2.5}$.5 fractions are assumed to be 71% and 52% respectively of the Total particulate matter emitted.

(b)   Generic factors

In a similar manner to Section 7.1.6(b), and based on the same referenced information sources, emission factors based on achievable emission rates from various liquid-fired combustion plant can be used in Equation 5. Relevant emission factors for liquid-fired plant are given in Table 23 (in terms of net heat input), and the same methodology should be used as that outlined in Section 7.1.6(b).

Table 23 – Liquid fuel-firing generic emission factors (net basis)

Technology	Emission factor	Particulate matter		NOx		CO	
		mg/MJ	mg/m³	mg/MJ	mg/m³	mg/MJ	mg/m³
Gas turbine (after 1994)*	EF	0	0	105	125	50	60
	Threshold for BRT (MWth)	-		30		63	
Gas turbine (pre-1994)*	EF	0	0	140	165	84	100
	Threshold for BRT (MWth)	-		23		38	
Boilers, 20-50MW, L/M/H fuel oil–firing**	EF	42	150	125	450	42	150
	Threshold for BRT (MWth)	8		25		75	
Boilers, 20-50MW, distillate firing**	EF	28	100	55	200	42	150
	Threshold for BRT (MWth)	12		58		75	
Compression ignition engine, SCR***	EF	40	50	125	150	125	150
	Threshold for BRT (MWth)	8		25		25	

Note:
* Use HMSO. Process Guidance Note IPR1/2 Combustion Processes: gas turbines, September 1994, ISBN 0-11-752954-0.
**Use Local Authority Unit. Assessment for second revision of PG1/3, Process Guidance Note for Part B. Boilers and furnaces with a net rated thermal input of 20 – 50 MWth.
***Use HMSO. Process Guidance Note S2 1.03 Combustion processes: gas turbines, September 1995 ISBN 0-11-753166-9.

For liquid fuel-fired plants incorporating SCR, an emission factor of 3 mg/MJ (10 mg/m³) for ammonia can be used.

For unabated emissions, the PM_{10} fraction can be assumed to be 45% of the Total particulate matter emitted, rising to 80% for plant with ESPs or bag filters and dry FGD and 90% for plant with ESPs or bag filters and wet FGD.

7.1.8 Emission factors for natural gas combustion

(a)   Electricity Supply Industry (ESI)

In a similar manner to Section 7.1.6(a), the UK ESI emission factors are listed in Table 24 for natural gas-fired plant. Further detail on these emission factors is contained in the ESI methodology.

Also included in Table 24 are the approximate GJ of energy that would be required to exceed the reporting thresholds given the listed emission factors and burning only natural gas.

Table 24 – 2013 UK ESI PI emission factors for large combustion plant

Pollutant species	Emission factor (g/GJ gas burnt) for gas firing (based on GCV)	[GJ of energy giving rise to numerical reported value]
Dioxins and furans (expressed as I-TEQ)	0	[-]
Dioxins and furans (expressed as WHO-TEQ)	0	[-]
PCBs (expressed as WHO-TEQ)	0	[-]
Benzo(a)pyrene (BaP)	0	[-]
Anthracene	0	[-]
Benzo(b)fluoranthene	0	[-]
Benzo(g,h,i)perylene	0	[-]
Benzo(k)fluoranthene	0	[-]
Chrysene	0	[-]
Fluoranthene	0	[-]
Indeno(1,2,3-cd)pyrene	0	[-]
Naphthalene	0	[-]
Methane	3.7	[2,702,700]
Non-methane volatile organic compounds	0.9	[11,111,000]
Carbon monoxide	13	[7,692,300]
SO_3 (reported as part of sulphur oxides – SO_2 and SO_3 as SO_2)	0	[-]
Nitrous oxide	0.5	[20,000,000]

NO_x emissions from CCGT and gas-fired plant are generally calculated from continuous monitors.

For the combustion of natural gas, the ESI PI methodology advises a revised emission factor of 0 for particulate matter from gas turbine plant.

For gas turbines running on distillate fuel, for example during start-up, the emission factors given in Table 23 can be used, and 100% of the Total particulate matter emission are assumed to be PM_{10} and 50% $PM_{2.5}$. Note that from 2009, the ESI proposes that they will assume that 100% of Total particulate matter is $PM_{2.5}$, as a conservative estimate.

(b)   Generic factors

In a similar manner to Section 7.1.6(b), and based on the same referenced information sources, emission factors based on achievable emission rates from various natural gas-fired combustion plant can be used in Equation 5. Relevant emission factors for natural gas-fired plant are given in Table 25 (in terms of net heat input), and the same methodology should be used as that outlined in Section 7.1.6 (b). Note that the emission factors are based on net calorific values (NCV).

Table 25 – Natural gas fuel-firing generic emission factors (net basis)

Technology	Emission factor	Particulate matter		NO_x		CO	
		mg/MJ	mg/m³	mg/MJ	mg/m³	mg/MJ	mg/m³
Gas turbine, after 1994*	EFi (mg/MJ)	0	0	50	60	50	60
	Threshold for BRT (MW_th)	-		63		63	
Gas turbine, pre-1994*	EFi (mg/MJ)	0	0	105	125	84	100
	Threshold for BRT (MW_th)	-		30		38	

Technology	Emission factor	Particulate matter		NO_x		CO	
		mg/MJ	mg/m^3	mg/MJ	mg/m^3	mg/MJ	mg/m^3
Boilers, 20-50MW, Flue gas recirculation (FGR)**	EFi (mg/MJ)	1	5	39	140	30	100
	Threshold for BRT (MW$_{th}$)	317		81		106	
Dual fuel compression ignition engine, SCR***	EFi (mg/MJ)	15	20	85	100	375	450
	Threshold for BRT (MW$_{th}$)	21		37		9	
Dual fuel compression ignition engine, lean burn***	EFi (mg/MJ)	15	20	125	150	125	150
	Threshold for BRT (MW$_{th}$)	21		25		25	
Spark ignition engine, SCR***	EFi (mg/MJ)	0	0	85	100	125	150
	Threshold for BRT (MW$_{th}$)	-		37		25	
Spark ignition engine, lean burn, exhaust gas recirculation (EGR)***	EFi (mg/MJ)	0	0	125	150	125	150
	Threshold for BRT (MW$_{th}$)	-		25		25	

Note:
*Use HMSO. Process Guidance Note IPR1/2 Combustion Processes: gas turbines, September 1994, ISBN 0-11-752954-0.
**Use Local Authority Unit. Assessment for second revision of PG1/3, Process Guidance Note for Part B. Boilers and furnaces with a net rated thermal input of 20 – 50 MWth.
***Use HMSO. Process Guidance IPC S3 1.01 Combustion processes Supplementary Guidance Note, November 1995 ISBN 0-11-310183.

For both compression ignition engines and spark ignition engines, a factor of 170 mg/MJ (200 mg/m^3) can be used for NMVOCs. For natural gas-fired plants incorporating SCR, an emission factor of 8 mg/MJ (10 mg/m^3) for ammonia can be used.

Apart from mercury, trace metallic elements in natural gas are assumed to be zero. For mercury, an emission factor of 1 x 10^{-4} mg/m^3 of gas burnt can be used to calculate mercury vapour emissions. In this case, greater than 1 x 10^{10} m^3 of gas would need to be burnt in a year to exceed the reporting threshold.

The PM$_{10}$ and PM$_{2.5}$ fractions can be assumed to be 100% of the total particulate matter emitted when burning natural gas.

7.1.9   Fuel analysis data

(a)   General

The use of fuel analysis data to determine emissions is similar to the use of emission factors.

The basic equation used in fuel analysis emission calculations is:

Equation 6

E   =   Q$_f$ x [Op hours] x [PC$_f$/100] x (MW$_p$ / EW$_f$)

Where:	E	Emission of pollutant (kg/yr)
	Q$_f$	Fuel use (kg/hr)
	PC$_f$	Pollutant concentration in the fuel (%)
	Op hours	Operating hours per year (hr/yr)
	MW$_p$	Molecular weight of pollutant as emitted after combustion
	EW$_f$	Elemental weight of pollutant as present in fuel

Equation 6 is the method usually used for calculating SO_2 emissions where it is normally assumed that all of the sulphur in the fuel is converted to SO_2. However, when using the equation for coal-fired plant, it is assumed that 5% of the sulphur is retained in the ash.

Where the pollutant concentration in the fuel is consistent over the averaging period (i.e. one year), Equation 6 can be written as:

E   =   M x [PC$_f$/100] x (MW$_p$ / EW$_f$)

Where:	E	Emission rate of pollutant in (kg/yr)
	M	Mass of fuel burnt in one year (kg/yr)
	PC$_f$	Pollutant concentration in the fuel (%)
	MW$_p$	Molecular weight of pollutant as emitted after combustion
	EW$_f$	Elemental weight of pollutant as present in fuel

Example 6

This example shows how SO_2 emissions can be calculated from oil combustion, based on fuel analysis results and fuel flow information. It is assumed that the facility operates using oil for 150 hours per year and that abatement of SO_2 does not occur.

Q$_f$	2000 kg/yr
PC$_f$	1.17%
MW$_p$	64
EW$_f$	32
Op Hours	1500 hr/yr
E = Q$_f$ x PC$_f$ x (MW$_p$/EW$_f$) x [Op Hours]	
E = [(2000) x (1.17/100) x (64/32) x 150] kg/yr	
E = 7.02 x 10^3 kg/yr	

Equation 6 can also be used for volatile elements such as fluorine and chlorine as well as trace metallic pollutants, although some of these species are retained in the plant, either in the ash or in abatement equipment (see below). When using Equation 6, you should be aware that the amount of pollutants present in the fuel can vary significantly.

For UK ESI plant, the trace element concentration in the coal is calculated as a yearly weighted mean average for each plant, based on the delivered tonnage of coal. Where coals have not been analysed for trace element content, then you should use an average value for coals from a similar geographic region.

(b)   Solid fuel analysis

For elements that are effectively captured in either bottom ash or fly ash, Equation 6 can result in the overestimation of emissions. In addition, emission quantities of volatile and semi-volatile components will greatly depend on the emission temperature and abatement collection efficiency as volatile and semi-volatile substances can condense on fine particulate matter. Increasing the emission temperature may significantly increase the pollutant release rate of volatile components. Any changes to the process conditions that may affect pollutant partitioning or capture should be taken into account in emission calculations by the determination of plant-specific retention and enrichment factors (see below).

Mass emissions of trace metallic elements from coal combustion can be calculated indirectly from the amount of total particulate matter emitted, corrected by factors representing the concentration of the trace element in the coal and how much of the element is chemically present in the ash, using the following equations. The total emission is the sum of the emission from the non-volatile and volatile phases:

Equation 7

Non-volatile phase:

$$E_{nv} \quad = \quad PC_{coal} \text{ x } (100 \text{ / } AA) \text{ x } F \text{ x } R \text{ x } PM$$

Equation 8

Volatile phase:

$$E_{v} \quad = \quad PC_{coal} \text{ x } (1 - F) \text{ x } CB$$

Where:	E_{nv}	Non-volatile pollutant emission (kg/yr)
	E_{v}	Volatile pollutant emission (kg/yr)
	PC_{coal}	Trace element weight fraction in the coal (-)
	AA	Average ash mass percentage in coal (%)
	F	Retention factor in ash (-)
	R	Enrichment factor (-)
	PM	Particulate matter emission (kg/yr)
	CB	Coal burned (kg/yr)

Common enrichment and retention factors that are used across UK coal-fired ESI plant are given in Table 26. These factors are appropriate for exhaust gas temperatures of less than approximately 130°C. For higher exhaust gas temperatures the factors may differ, especially for the more volatile elements, and you should therefore use site-specific factors.

The use of flue gas desulphurisation (FGD) will lead to the retention of sulphur from the emission, but it will also lead to the retention of soluble acid halides such as HCl and HF. In the absence of site specific data for FGD, retention factors for HCl and HF should be taken as 98% and 72% respectively. The additional factors given in Table 26 for FGD are for wet limestone/gypsum systems.

Table 26 – 2013 UK ESI PI coal combustion factors

Element	Retention factor (F)	Enrichment factor (R)	FGD retention factor (vapour)
Arsenic	1	3.4	-
Selenium	0.8	9.0	0.65
Lead	1	2.9	-
Antimony	1	3.6	-
Nickel	1	1.9	-
Chromium (total)	1	1.7	-
Copper	1	2.0	-
Manganese	1	1.7	-
Vanadium	1	1.4	-

Element	Retention factor (F)	Enrichment factor (R)	FGD retention factor (vapour)
Zinc	1	4	-
Cadmium	1	4.5	-
Mercury	0.5	4.0	0.5

In order to use Equations 7 and 8, it is necessary to know the composition of the coal in terms of the percentage of trace metallic elements present. As coal composition can vary significantly depending on the source of the fuel, you should obtain information on the trace elements from the supplier, or have specific coal analysis carried out.

Fuel composition should also be taken into account in determining pollutant emissions from subsidiary or substitute fuels. In the absence of other data, for fuels such as biomass that have a low ash content, the enrichment and retention factors given above can be used.

(c)   Liquid fuel analysis

Equation 8 can be used to calculate trace metallic emissions from oil-fired plant. As a generality within the ESI methodology it is assumed that for large, heavy fuel oil plant with particulate or grit arrestors a retention factor of 0.75 can be used for trace elements. Appropriate retention factors should be determined for other abatement plant. In the absence of abatement, the retention factor would be zero.

As with coal, information on the composition of the trace elements in the fuel should be obtained from the supplier or be measured.

Emissions of halogens from oil-fired plant can be assumed to be zero.

(d)   Natural gas analysis

As indicated in Section 7.3.5(b), apart from mercury, natural gas supplies in the UK are currently assumed to have zero trace metal content. Emissions of halogens from natural gas-fired plant are also assumed to be zero.

Where no specific gas analysis is available and in order to calculate emissions from gas venting, natural gas should be assumed to comprise 1% CO_2, 1% nitrogen, 92% CH_4 and 6% NMVOCs.

7.1.10 Fugitive emissions

For solid fuel plant, particulate matter emissions can occur by dust blown from coal stocks and ash storage areas. However, these can be assumed to be low in comparison to stack emissions unless specific events have occurred which are known to have released significant quantities of material off-site.

Techniques for estimating fugitive emissions from the surface of stockpiles are limited. Options include measuring ambient dust levels upwind and downwind of the source of interest and/or applying predictive mathematical models.

Methane (CH_4)and other hydrocarbon emissions from coal stocks and oil tank filling can be assumed to be small in relation to emissions through the stacks. For natural gas-fired plant, where gas is vented to atmosphere for operational and maintenance purposes, the mass emissions of CO_2, CH_4 and NMVOCs should be calculated from the gas composition.

7.2 Emissions to water and wastewater

7.2.1 Relevant pollutants

A variety of substances need to be considered when reporting emissions to water or transfers in wastewater to sewer. The main ones are illustrated in Table 27. The table should be taken as a guide only, and you should verify that there are no other pollutants emitted from the process. The significance of each parameter depends on the specific plant configuration and the process applied, which also determines the type and amount of pollutant present in the wastewater prior to treatment.

Table 27 – Guide on main reportable substances likely to be emitted to water

Substance	Substance
Arsenic	Zinc
Cadmium	Iron
Chromium	Ammonia (total)
Copper	Nitrogen (total as N)
Lead	Phosphorus (total as P)
Mercury	Chlorides
Nickel	Fluorides

7.2.2 Emission sources

Emissions to water generally arise from the following sources:

- Cooling water systems;
- Demineralised water treatment plant;
- Boiler blowdown;
- FGD wastewater treatment plant;
- Ash transport wastewater;
- Surface water run-off from storage areas (e.g. fuel, ash, FGD material);
- Cleaning water.

Notwithstanding the above, you should consider all emission sources to water and characterise the flows and emission concentrations from each source.

7.3 Off-site waste transfers

7.3.1 Relevant wastes

Typical wastes and by-products generated in this sector are:

- Bottom ash and/or boiler slag;
- Fly-ash;
- Fluidised bed ash;
- Flue gas desulphurisation residues and by-products;
- Special wastes (e.g. solvents);
- Metallic wastes;
- Chemical wastes;
- Waste oils;
- General waste.

Transboundary shipments of hazardous waste
For transboundary movements of hazardous waste (outwith the United Kingdom), the name and address of the recoverer or the disposer of the waste and the actual recovery or disposal site have to be reported.

7.4   Useful references

HMSO. Process Guidance IPC S3 1.01 Combustion processes Supplementary Guidance Note, November 1995 ISBN 0-11-310183.

HMSO. Process Guidance Note S2 1.01 Combustion processes: large boilers and furnaces 50MW(th) and over, November 1995 ISBN 0-11-753206-1.

HMSO. Process Guidance Note S2 1.03 Combustion processes: gas turbines, September 1995 ISBN 0-11-753166-9.

HMSO. Process Guidance Note IPR1/2 Combustion Processes: gas turbines, September 1994, ISBN 0-11-752954-0.

Local Authority Unit. Assessment for second revision of PG1/3, Process Guidance Note for Part B. Boilers and furnaces with a net rated thermal input of 20 – 50 MWth.

Local Authority Unit. Assessment for second revision of PG1/4, Process Guidance Note for Part B. Gas turbines 20 – 50 MWth rated thermal input.

8 Chemical sector guidance

This Section covers activities that are regulated as "Chemical industry activities" under the Pollution Prevention and Control (Scotland) Regulations 2012 (as amended; PPC Regulations). Included within the scope are Part A prescribed/listed activities regulated under Chapter 4, Sections 4.1 – 4.7 of the PPC Regulations. The relevant sub-sections are given below:

4.1	Organic chemicals
4.2	Inorganic chemicals
4.3	Chemical fertiliser production
4.4	Biocide production
4.5	Pharmaceutical production
4.6	Explosives production
4.7	Manufacturing activities involving ammonia

8.1 Emissions to air

The main emissions from chemical activities will depend on the nature of the activity being conducted. The following tables describe the main emissions associated with different types of chemical activity.

Table 28 – Air pollutants emitted by the organic chemicals sector

Air pollutants		
Aldrin	Endrin	Nickel
Ammonia	Ethylene oxide	Nitrogen dioxide (oxides of nitrogen – NO & NO_2 as NO_2)
Anthracene	Ethylene dichloride (1,2-dichloroethane)	Nitrous oxide
Arsenic	Fluorine and inorganic compounds as HF	Non-methane volatile organic compounds
Benzene	Formaldehyde	Particulate matter (including PM_{10} and $_{2.5}$)
1,3-butadiene	Halons	Pentachlorobenzene
Cadmium	Heptachlor	Pentachlorophenol
Carbon dioxide	Hexabromobiphenyl	Perfluorocarbons
Carbon monoxide	Hexachlorobenzene	Polychlorinated biphenyls
Carbon tetrachloride	Hexachlorocyclohexane	Polycyclic aromatic hydrocarbons
Chlordane	Hydrochlorofluorocarbons	Sulphur dioxide (Oxides of sulphur – SO_2 and SO_3 as SO_2)
Chlordecone	Hydrofluorocarbons	Sulphur hexafluoride
Chlorine and inorganic compounds as HCl	Hydrogen chloride	Styrene
Chlorofluorocarbons	Hydrogen cyanide	Tetrachloroethane
Chloroform	Lead	Tetrachloroethylene
Chromium	Lindane	Toluene
Copper	Mercury	Toxaphene
Dichloromethane (methylene chloride)	Methane	Trichlorobenzene
Dieldrin	Methyl chloride	Trichloroethylene
Di-(2-ethyl hexyl) phthalate	Methyl chloroform (trichloroethane)	Vinyl chloride
Dioxins and furans	Naphthalene	Xylene
		Zinc

Table 29 – Air pollutants emitted by the inorganic chemicals sector

Air pollutants	
Ammonia	Hydrogen fluoride
Arsenic	Lead
Benzene	Mercury
Cadmium	Methane
Carbon dioxide	Methyl chloroform (trichloroethane)
Carbon monoxide	Nickel
Carbon tetrachloride (tetrachloromethane)	Nitrogen dioxide (oxides of nitrogen – NO and NO_2 as NO_2)
Chlorine & inorganic compounds as HCl	Nitrous oxide
Chlorofluorocarbons	Non-methane volatile organic compounds
Chloroform (trichloromethane)	Particulate matter (including PM_{10})
Chromium	Pentachlorobenzene
Copper	Pentachlorophenol
Dichloromethane (methylene chloride)	Perfluorocarbons
Dioxins and furans	Phenol
Ethylene dichloride (1,2-dichloroethane)	Polycyclic aromatic hydrocarbons
Fluorine and inorganic compounds as HF	Sulphur dioxide (oxides of sulphur – SO_2 and SO_3 as SO_2)
Halons	Sulphur hexafluoride
Hexachlorobenzene	Tetrachloroethane
Hexachlorocyclohexane	Tetrachloroethylene
Hydrochlorofluorocarbons	Trichlorobenzenes
Hydrofluorocarbons	Trichloroethylene
Hydrogen chloride	Zinc
Hydrogen cyanide	

Table 30 – Main air pollutants emitted by the chemical fertiliser sector

Main air pollutants	Main sources
Ammonia	Ammonium nitrate/phosphate production
Carbon dioxide	Ammonium phosphate production
Carbon monoxide	Ammonium phosphate production
Hydrogen chloride	Single super phosphate manufacture
Hydrogen fluoride (fluorine and inorganic compounds – as HF)	Single super phosphate manufacture
Methane	Ammonium nitrate/phosphate production
Nitrogen dioxide (oxides of nitrogen – NO and NO_2 as NO_2)	Ammonium nitrate production
Particulate matter (including PM_{10} and $_{2.5}$)	Ammonium nitrate/phosphate and NPK production, fugitive dust emissions from conveyors, screens, etc. Single super phosphate production
Sulphur dioxide (oxides of sulphur – SO_2 and SO_3 as SO_2)	Ammonium phosphate production

Table 31 – Main air pollutants emitted by the plant health products and biocides sector

Main air pollutants	Main sources
Carbon dioxide	Reaction, distillation and blending operations
Chlorine and inorganic compounds as HCl	Reaction, distillation and blending operations
Particulate matter (including $PM_{10 \text{ and } 2.5}$)	Dusts from vessel charging, crushing/pulverising and handling, blending, milling, packaging
Volatile organic compounds	Reaction, distillation and blending operations

Table 32 – Main air pollutants emitted by the pharmaceutical sector

Main air pollutants	Main sources
Particulate matter (including $PM_{10 \text{ and } 2.5}$)	From vessel charging, sieving, milling, weighing, mixing, blending, granulating, tablet manufacture, filling and packing
Volatile organic compounds	From reaction, separation, drying, tablet manufacture and aerosol preparation

Table 33 – Main air pollutants emitted by the explosives sector

Main air pollutants	Main sources
Nitrogen dioxide (oxides of nitrogen – NO and NO_2 as NO_2)	Glycerol or cellulose nitration reactions

Table 34 – Main air pollutants emitted by manufacturing carbon disulphide and ammonia

Main air pollutants	Main sources
Ammonia	Start-up stages (NH_3 production), pressure relief vents, condensate stripper
Carbon dioxide	CO_2 removal plant (NH_3 production), start-up, primary reformer flue gas, pressure relief vents
Carbon monoxide	Start-up stages (NH_3 production), primary reformer flue gas, pressure relief vents
Methane	Start-up stages (NH_3 production), pressure relief vents
Nitrogen dioxide (oxides of nitrogen – NO and NO_2 as NO_2)	Furnaces (CS_2 production), primary reformer flue gas (NH_3 production)
Sulphur dioxide (oxides of sulphur – SO_2 and SO_3 as SO_2)	Combustion of CS_2 and H_2S in flare system, primary reformer flue gas (NH_3 production)

8.1.1 Point source emissions

These emissions are exhausted via a stack or vent, i.e. a single point source into the atmosphere. Abatement equipment, e.g. scrubbing units, fabric filters (bag house) can be incorporated into the exhaust system prior to discharge to atmosphere.

8.1.2 Fugitive emissions

Fugitive emissions are those that are not released from a point source such as a stack. In some chemical production activities fugitive, or diffuse, emissions may be more significant than point source emissions. Fugitive VOC emissions are often a very significant factor in emissions to air from large volume organic chemicals (LVOC) installations.

Some examples of the potential sources of fugitive emissions to air are:

- The loading and unloading of materials into transport containers;
- Storage areas (e.g. bays, stockpiles, etc.);
- Transferring material between vessels;
- Conveyor systems;
- Pipework and ductwork systems (e.g. pumps, valves, flanges, equipment vents);
- Accidental loss of containment from failed plant and equipment;
- Poor building containment and extraction.

8.2 Emissions to water and wastewater

8.2.1 Relevant pollutants & emission sources

Water discharges from chemical processes arise from the air abatement equipment (e.g. wet scrubbers), storm water, cooling water, boiler blow-down, raw material handling areas, accidental emissions of raw materials, products or waste materials, fire-fighting and from on-site effluent treatment. An indicative list of water emissions for the organic/inorganic sectors is given in Tables 35 and 36 respectively. The main water emissions, and their sources, from the remaining chemical sub-sector activities, are shown in Tables 37 – 41. These should be taken as a guide only, and you should verify the presence of any other pollutants emitted from the process.

Table 35 – Water pollutants emitted by the organic chemicals sector

Water pollutants		
Alachlor	Di-(2-ethyl hexyl) phthalate	Octylphenols
Aldrin	Dioxins and furans	Organotin compounds
Anthracene	Diuron	Pentachlorobenzene
Arsenic	Endosulphan	Pentachlorophenol
Atrazine	Endrin	Phenols
Benzene	Ethyl benzene	Phosphorus (total)
Benzo(g,h,i)perylene	Ethylene oxide	Polychlorinated biphenyls
Brominated diphenylethers	Fluorides as total F	Polycyclic aromatic hydrocarbons
Cadmium	Halogenated organic compounds (as AOX)	Simazine
Chlordane	Heptachlor	Tetrachloroethylene
Chlordecone	Hexabromobiphenyl	Tetrachloromethane
Chlorfenvinphos	Hexachlorobenzene	Toluene
Chlorides as total Cl	Hexachlorobutadiene	Toxaphene
	Hexachlorocyclohexane	Tributyltin
Chloropyrifos	Lead	Trichlorobenzenes
Chromium	Lindane	Trichloroethylene
Copper	Mercury	Trichloromethane (Chloroform)
Cyanides as total CN	Mirex	Trifluralin
Dichlorodiphenyltrichloroethane	Naphthalene	Triphenyltin
Ethylene dichloride (1,2-dichloroethane))	Nickel	Vinyl chloride
Dichloromethane	Nitrogen (total)	Xylenes
Dieldrin	Nonylphenols	Zinc

Table 36 – Water pollutants emitted by the inorganic chemicals sector

Water pollutants	
Arsenic	Lead
Asbestos	Mercury
Benzene	Nickel
Benzo(g,h,i)perylene	Nitrogen (total)
Cadmium	Nonylphenols
Chlorides as total Cl	Octylphenols
Chromium	Pentachlorobenzene
Copper	Phenols
Cyanides as total CN	Phosphorus (total)
Dichloromethane	Polycyclic aromatic hydrocarbons
Ethylene dichloride (1,2-dichloroethane)	Toluene
Ethyl benzene	Total organic carbon
Fluorides as total F	Xylenes
Halogenated organic compounds (as AOX)	Zinc
Hexachlorobenzene	
Hexachlorobutadiene	
Hexachlorocyclohexane	

Table 37 – Main water pollutants emitted by the chemical fertiliser sector

Main water pollutants	Main sources
Cadmium	Single super phosphate manufacture
Mercury	Single super phosphate manufacture

Table 38 – Main water pollutants emitted by the plant health products and biocides sector

Main water pollutants	Main sources
Aqueous organics	Reaction, separation and fermentation

Table 39 – Main water pollutants emitted by the pharmaceutical sector

Main water pollutants	Main sources
Aqueous organics	Reaction, separation and fermentation

Table 40 – Main water pollutants emitted by the explosives sector

Main water pollutants	Main sources
Acidic products	Nitration reactions

Table 41 – Main water pollutants emitted by manufacturing carbon disulphide and ammonia

Main water pollutants	Main sources
Mercury	Ion exchange resin regeneration (ammonia production)

The resulting discharge of the above substances depends on the 'in process' preventative measures (good housekeeping, re-use) and the presence and technical standards of wastewater treatment facilities. Notwithstanding the above, you should consider all emission sources to water and characterise the flows and emission concentrations from each source.

8.3 Off-site waste transfers

8.3.1 Relevant wastes

In general the waste streams from chemical facilities can be classified into types as follows:

- By-products for which no internal use or external sale is available;
- Residues from separation processes such as distillation;
- Catalysts which have declined in performance and require replacement;
- Filter cake, activated carbon, ion exchange resins, molecular sieves and other treatment materials;
- Sludges from wastewater treatment;
- Emptied containers and packaging;
- Maintenance and construction materials.

The key substances likely to be present can be derived from knowledge of the process, materials of construction, corrosion/erosion mechanisms and materials related to maintenance. The presence of substances created by abnormal operation should be identified.

Transboundary shipments of hazardous waste
For transboundary movements of hazardous waste (outwith the United Kingdom), the name and address of the recoverer or the disposer of the waste and the actual recovery or disposal site have to be reported.

9   Glossary

ACI	Animal Carcass Incineration
ALT	Alternative (measurement method)
AOX	Adsorbable Organic Halogens
APC	Air Pollution Control
ART	Above Reporting Threshold
As	Arsenic
BaP	Benzo(a)pyrene
BAT	Best Available Techniques
BCA	British Cement Association
BDEs	Brominated Diphenylethers
BOS	Basic Oxygen Steelmaking
BRT	Below Reporting Threshold
BS	British Standard
BSI	British Standards Institute
BTX	Benzene, Toluene, Xylene
CAR	Water Environment (Controlled Activities) (Scotland) Regulations 2011
CCGT	Combined Cycle Gas Turbine
CCU	Catalytic Cracking Unit
CEMS	Continuous Emission Monitoring System
CEN	European Committee for Standardisation
Cd	Cadmium
CF	Conversion Factor
CFCs	Chlorofluorocarbons
CH_4	Methane
CHP	Combined Heat and Power
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COD	Chemical Oxygen Demand
CoT	Committee on Toxicity
CN	Cyanide
Cr	Chromium
CRM	Certified Reference material
Cu	Copper
CWI	Clinical Waste Incineration
D&R	Disposal and Recovery
DI	Drum Incineration
EAF	Electric Arc Furnace
EC	European Commission
EEA	European Environment Agency
EF	Emission Factor
EGR	Exhaust Gas Recirculation
EIA	Environmental Impact Assessment
ELV	Emission Limit Value
EPER	European Pollutant Emission Register
ESI	Electricity Supply Industry
ESP	Electrostatic Precipitator
ETP	Effluent Treatment Plant
EU	European Union
EU ETS	European Union Emissions Trading System
E-PRTR	European Pollutant Release and Transfer Register
ESP	Electrostatic Precipitator
EWC	European Waste Catalogue
FCCU	Fluidised Catalytic Cracking Unit
FGD	Flue Gas Desulphurisation

FGR	Flue Gas Recirculation
FSF	Fully Slatted Floor
GCV	Gross Calorific Value
FID	Flame Ionisation Detector
GHG	Greenhouse Gas
HCFCs	Hydrochlorofluorocarbons
HCl	Hydrogen Chloride
HCN	Hydrogen Cyanide
HF	Hydrogen Fluoride
HFCs	Hydrofluorocarbons
HFO	Heavy Fuel Oil
Hg	Mercury
H_2S	Hydrogen Sulphide
HW	Hazardous Waste
HWI	Hazardous Waste Incineration
IBC	Intermediate Bulk Container
IED	Industrial Emissions Directive
INT	Internationally Approved (measurement standard)
IOWWTP	Independently-operated Wastewater Treatment Plant
IPC	Integrated Pollution Control
IPPC	Integrated Pollution Prevention and Control
I-TEF	International Toxicity Equivalency Factor
I-TEQ	International Toxicity Equivalents of Dioxins
JEP	Joint Environment Programme
K	Kelvin (unit of temperature)
LOD	Limit of Detection
LPG	Liquefied Petroleum Gas
LRTAP	Long-range transboundary air pollution (convention on)
LVOC	Large Volume Organic Chemicals
MAB	Mass Balance Method
MBq	Mega Becquerel
MCERTS	(Environment Agency's) Monitoring Certification Scheme
$Mg(OH)_2$	Magnesium Hydroxide
Mn	Manganese
MRR	Monitoring and Reporting Requirements
MSW	Municipal Solid Waste
MWI	Municipal Waste Incineration
NAEI	National Atmospheric Emissions Inventory
NCV	Net calorific value
Ni	Nickel
NH_3	Ammonia
NIC	National Identity Code
NLA	No Longer Applicable
NO_x	Oxides of nitrogen (mixture of NO and NO_2)
NO_2	Nitrogen Dioxide
NO	Nitric Oxide
N_2O	Nitrous Oxide
NRB	National or Regional Binding (measurement method)
OCC	Opencast Coal
OTH	Other (measurement method)
NMVOCs	Non-methane Volatile Organic Compounds
PAHs	Polycyclic Aromatic Hydrocarbons
Pas	Publically Available Standard
Pb	Lead
PCBs	Polychlorinated Biphenyls

PCDDs	Polychlorinated Dibenzodioxins
PCDF	Polychlorinated Dibenzofurans
PER	Measurement method already prescribed by the competent authority (SEPA) in a license or permit for that facility
PF	Pulverised Fuel
PFBC	Pulverised Fuel Bed Combustion
PFCs	Polyfluorinated Hydrocarbons
PI	Pollution Inventory
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter (<2.5µm aerodynamic diameter)
PM_{10}	Particulate Matter (<10µm aerodynamic diameter)
PPC	Pollution Prevention and Control (Scotland) Regulations 2012 (as amended)
Ppm	Parts per million
Ppmv	Parts per Million by Volume
PSF	Partially Slatted Floor
PVC	Polyvinyl Chloride
RCF	Recycled Fibre
RET	Release Estimation Technique
RS	Radioactive Substances
Sb	Antimony
SCR	Selective Catalytic Reduction
SIC	Standard Industry Classification
SLF	Substitute Liquid Fuel
Sn	Tin
SNCR	Selective Non-catalytic Reduction
SO_x	Oxides of Sulphur (mixture of SO_2 and SO_3)
SO_2	Sulphur Dioxide
SO_3	Sulphur Trioxide
SRU	Sulphur Recovery Unit
SSC	Sector Specific Calculation
SSI	Sewage Sludge Incineration
SWS	Sour Water Scrubber
SPRI	Scottish Pollutant Release Inventory
TOC	Total Organic Carbon
TPM	Total Particulate Matter
TSS	Total Suspended Solids
UKSIC	United Kingdom Standard Industry Classification
UNECE	United Nations Economic Commission for Europe
UNFCCC	United Nations Framework Convention on Climate Change
USEPA	United States Environmental Protection Agency
UWWTP	Urban Wastewater Treatment Plant
V	Vanadium
VC	Vinyl Chloride
VDU	Vacuum Distillation Unit
VOCs	Volatile Organic Compounds
WESP	Wet Electrostatic Precipitator
WEWS	Water Environment and Water Services (Scotland) Act 2003
WHO	World Health Organisation
WHO-TEF	WHO Toxicity Equivalency Factor
WHO-TEQ	Toxicity Equivalents of Dioxins
WML	Waste Management Licence
WWTP	Wastewater Treatment Plant
Zn	Zinc